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THE ELECTRICAL TRADES ASSOCIATION.

The movement which originated in Philadelphia, by which manufacturers of and dealers in electrical apparatus and supplies notify each other of the customers who are becoming delinquent, seems to be rapidly spreading. In addition to the establishment of a similar association in Boston, a committee has been appointed to arrange the preliminaries for a kindred organization in New York. It is to be inferred that Chicago and other cities will follow the example set by the East. The larger the number of local organizations, the more beneficial will such a movement prove to all concerned. There are so many excellent reasons in favor of such an interchange of information that leading houses will feel that they cannot afford to withhold encouragement from a scheme which has proven so successful, not only among electrical houses which have tried it, but previously among the plumbing trade, where a similar organization has been in operation for many years.

COLD LIGHT.

We commend to our readers the interesting article elsewhere in this issue on "Cold Light," in which Prof. Stine very clearly discusses the conditions, at least as far as known, upon which the possibility of its production depends. As will be seen, our present method of obtaining light is excessively crude from an absolute standpoint. Even with a source of light as efficient, compared with other sources, as the incandescent lamp, from 100 per cent. of energy expended we only obtain a few per cent. of optical energy, and 90 odd per cent. of heat which we do not want. In other words, the light produced is merely incidental to the production of heat, which latter valuable form of energy is not only thus wasted, but its presence is a positive nuisance. Unfortunately we can as yet only grope blindly for a way out of the difficulty, for, notwithstanding the hypotheses offered, no definite promise is held in store for the immediate future. The coming century has within its possibilities two solutions—one most probably bound up in the other—which, if achieved, will give a lustre besides which that of the nineteenth century, glorious as it is, will pale—the production of "cold light" and the transformation without inseparable loss, of the energy of carbon into useful energy.

STANDARD ELECTRICAL RULES.

The announcement in another column that an invitation has been extended to the Underwriters' National Association to participate in the formulation of a code of standard rules for electrical construction and operation, would seem to remove the last serious obstacle to the success of a most praiseworthy object. The delegates to the conference which is to meet several weeks hence for the purpose of preparing such a standard code, will form a body of exceptional authority, and as still further strengthened by the attendance in an advisory capacity of the complimentary delegates whose names we print elsewhere, the result should be a set of rules not only superior to any others in existence, but of the highest intrinsic value. While the insurance interest, upon whose final action the general adoption of the proposed code depends, will be in a small minority, the character of the other delegates is such that we may expect a broad view to be taken of all the questions brought forward, and thus subsequent complications either entirely obviated or confined to grounds upon which they may be satisfactorily compromised. While in respect to some questions the electrical and insurance interests are naturally inclined to adopt different points of view, we believe that it is possible for them to come to an amicable arrange-

ment on disputed points if mutual jealousies and antagonisms are not aroused, and in this instance there is every reason to expect that each party will meet the other in the fair and conciliatory spirit upon which the full attainment of the worthy object in aim will so largely depend.

A MODERN CENTRAL STATION.

In another column we print an abstract of an interesting lecture delivered last week by Mr. Jno. W. Lieb, Jr., before the New York Electrical Society, which brings out several points of importance in connection with central station operation. The high electrical efficiency of a modern central station will be noted, the figures given being 92 per cent. over nine hours, and an all-day efficiency of 85 per cent. We regret to see again, however, the habitual misuse of the word "efficiency" as applied to the steam plant, particularly as in this case some readers may assume from the context that the enormous discrepancy between an efficiency of 8 per cent. or much less, and what he thinks should be a rational figure, is within human power to overcome. We cannot insist too strongly upon the desirability of basing engine efficiencies, not upon the absolute thermal efficiency, but upon a basis that obtains in the physical world we inhabit. To those who have a knowledge of the excellent character of the illumination furnished by the New York Edison Company, it will be a surprise to learn that the *average* drop in the distributing service is in the neighborhood of 9 per cent.—which fact should also tend to abate the ardor of those who would have us believe that central station people are too conservative in refusing to adopt two or two and one-half watt lamps. From Mr. Lieb's remark on motor service it would appear that the much coveted motor load is not the panacea generally supposed. Storage battery advocates should find much to please them in the final paragraphs of the abstract, for until we find the application referred to that will result in "leveling" the load line, they at the present time alone can offer a practical solution, though it be one only partial in character.

CONTRIBUTORY INFRINGEMENT.

The recent decision of Judge Townsend, enjoining the sale of certain parts of trolley mechanism, is interesting as applying the definition of contributory infringement to a case which all can appreciate. The defendants had made and sold certain trolley stands adapted to be used with the pole and wheel of the overhead under-running trolley—in some instances to repair or replace stands purchased from the owners of the Van Depoele patent, and in others used on account of certain advantages in their construction over those covered by said patent. In regard to the point that the plaintiffs should prove intention to aid in infringement, the court decides that the case falls under the rule that a defendant cannot escape liability for infringement when he makes and puts on the market an article, which, of necessity and to his knowledge, is used for the purpose of infringing a patent, as he thereby concerts with the user in invading the patentee's rights. In answer to the argument that the right to replace the stands in suit was a part of the invention transferred to the purchaser when he bought the equipment, the court decides that this argument might be applied to the wheels, the life of which is short, but it does not apply to the stands, as this is probably the most substantial, if not the chief, element in the patented combination, and which, as it appears, does not wear out quickly or break frequently as do other elements in the combination, such as poles, wheels and harps. Another argument advanced by the defendants was that their trolley stand is capable of a lawful as well as an unlawful use, by way of reparation or restoration of a patented device, and that the presumption must be that this is the purpose for which it is to be used. In reply the court held that it does not appear by advertisements or sales that its use was to be confined to such purposes, and since the stands are only applicable for performing the functions involved in the operation of the patent, the presumption is that the stands were intended to be so used; moreover, a suit for infringement cannot be defeated by merely showing that such devices can be used for some other purpose. In considering the point that to enjoin the sale of a single element of a combination would give a patent a scope not covered by its claims, the court quoted a decision to the effect that the course of law is not to be turned aside because of a practical result which may give a patentee for the time being more than the Patent Office contemplated, nor is a patentee to be deprived of his just rights because under some circumstances he gets incidental advantages beyond what he expressly bargained for. A point made by the defense was that in one of the cases in suit the sale was of an improvement upon the original trolley stand, and therefore lawful. This is met by the statement that such a sale under such circumstances amounts to reconstruction and not repair; and that in this case there is no such temporary relation between the trolley stand element and the whole combination, as to raise a presumption that it was the intention of the inventor that it should be frequently replaced. In support of this view a decision is quoted, that a single substantial element of a patented combination that is not an ordinary piece of mechanism which can be purchased at any general hardware store, but which, on the other hand, is unique and can only be used in connection with such patented combination, is an infringement, as otherwise the other less important parts can be lawfully procured and the value of the patent thereby limited to the first sales made of it.

Accumulators in Germany.

In our issue of Jan. 4 we endeavored to explain the difference between the "Hagen" and the "Hagen" accumulators, both of which are made in Germany and, as might be expected, are often confused with each other. The makers of one of these have since written us as follows: "The firm Gottf. Hagen was established in the year 1827, and had the reputation of conducting one of the largest lead works of Germany long before any one thought of accumulators. The firm Gottf. Hagen also made accumulators (system De Khotinsky) before the accumulator works in Hagen were founded. When the firm began in 1890 to manufacture accumulators of its own system on an extensive scale, this department of the works was named 'Cologne Accumulator Works, Gottf. Hagen,' to avoid any confusion with the works in Hagen, and the accumulator was called the K. A. W. Accumulator or Accumulator System Gottf. Hagen. We see no reason why our accumulators should be confused with those of the Tudor type, considering, as we do, that our accumulators are far better than the latter; besides, a series of trials and tests made by authorities have proved beyond doubt the great superiority of our accumulators."

We notice that there is a further distinction between the names of the two kinds of Hagen accumulators, The name of the Hagen kind, which are not made by Hagen but are made in Hagen, is generally followed by a fraction, the numerator of which is a small i and the denominator a capital W, apparently to distinguish it from still another Hagen, having a different geographical location. We trust that the matter is now clear.

Electric Sleighs.

A contemporary from the Far East states that in St. Petersburg sleighs are being built which are to be driven by electricity, and owing to the very long Winter in that latitude this new method of propulsion is creating great interest. Unfortunately it does not state just how these sleighs are to be driven.

Energeer.

A correspondent at Indianapolis, Ind., writes to us suggesting that the word motorman be replaced by energeer, a combination of the words energy and engineer, and meaning the person in control of the *engine* and *energy!*

Nomenclature.

Nomenclature, says Prof. Cope in *Science*, is like pens, ink and paper; it is not science, but it is essential to the pursuit of science.

The National Electrical Exposition.

In connection with the electrical exposition to be held in New York next May, arrangements have been made for a very interesting historical and loan exhibit, to which it is intended to devote considerable space on the main floor. A committee, composed of T. C. Martin, Dr. Park Benjamin and E. L. Morse, has been asked to take the superintendence of this exhibit, and, having consented to do so, are already at work. Dr. Benjamin has one of the finest libraries in the world of early books on electricity, and these will be shown in cases, arranged chronologically with explanatory notes, portraits, autographs, etc. Mr. Morse, the son of Prof. S. F. B. Morse, is the possessor of an invaluable collection of telegraphic relics, curios, etc., including his father's notebooks and sketches; all of which will be shown. Mr. Martin, besides owning many objects of interest connected with the early days of electricity, has secured from Mr. Tesla, Mr. Elihu Thomson, Mr. Edison, Mr. Edward Weston, Mr. Stieringer and others no less well known, the loan of early and interesting apparatus, constituting a personal exhibit from each inventor of the most instructive nature. It is believed that, judging even from present indications, the historical and loan collection will far surpass anything of the kind ever attempted in this country.

The New York Electrical Trades Association.

As mentioned in the last issue of THE ELECTRICAL WORLD, a committee representing the Electrical Trades Association, of Philadelphia, met the representatives of the New York electrical trades at the Astor House, on Wednesday, March 4.

The principal electrical manufacturing and supply houses of the metropolis were represented.

The meeting was organized by the election of Mr. W. J. Johnston as chairman. Mr. Avery P. Eckert was chosen secretary.

The committee, Messrs. Trump, Bournonville and Wilkins, explained the object of the association, as mentioned briefly in last week's ELECTRICAL WORLD. The association is based on a similar organization which for years has proven successful in the plumbing trade. A number of instances were cited by which members of the association had been prevented from making bad debts by timely notice of delinquencies on the part of customers.

After a thorough discussion, the following committee was appointed to organize the New York Electrical Trades Association: Messrs. R. E. Gallaher, New York Insulated Wire Company; C. P. Geddes, Interior Conduit & Insulation Company; M. A. Gilmore, Western Electric Company; T. J. Smith, The E. S. Greeley & Co.; C. W. Price, *The Electrical Review;* P. C. Ackerman, American Electrical Works; J. J. Gorman, Manhattan Electrical Supply Company; Capt. Willard Candee, the Okonite Company; W. J. Johnston, THE ELECTRICAL WORLD.

Chairman Gallaher has called a meeting of this committee to arrange the preliminaries of the new association, and as all those interested, so far as heard from, heartily favor the establishment in New York of an association that have proven so beneficial in Philadelphia and in Boston, and which will doubtless also be speedily established in other cities, it is believed that practically the whole trade in the Empire City and the neighborhood round about will become members.

The arguments in favor of such co-operation among those engaged in the electrical trade and kindred interests are so many and so apparent that the movement cannot fail to appeal to manufacturers and dealers.

Van Depoele Trolley Infringement Suit.

A few months ago Judge Townsend, of the United States Circuit Court of the District of Connecticut, rendered a decision sustaining the validity of the Van Depoele under-running electric railway patent upon final hearing in a suit against the Winchester Avenue Railway Company. Shortly thereafter further infringement suits were brought in Connecticut against the Billings & Spencer Company, of Hartford, and the Kelsey Electric Railway Specialty Company, of New Haven. Judge Townsend has just decided these suits in favor of the Van Depoele patent, and granted motions for preliminary injunctions, after full argument on both sides.

The opinion states that the affidavits show that the defendants respectively made and sold certain trolley stands adapted to be used with the pole and wheel of the overhead under-running trolley system; that they have advertised the same for sale to the general public, and have sold them to jobbers in the open market. In some instances the defendants have sold such stands to repair or replace other stands purchased from the General Electric Company, and in the case of the Norwalk Street Railway Company, equipped by the General Electric Company, the defendants sold their trolley stands by reason of certain advantages in their construction, to replace those of the General Electric Company. The court relates that it further appears that the defendants have used a trolley pole in connection with their stands in their show room; and that they sold to one Hammer, representing himself to be an electrical contractor, one of such stands, equipped with a pole, harp and wheels, which they had heretofore used in their experiments in their shop.

The following facts are also adduced by the court as having a bearing upon the questions to be hereafter discussed. The entrance of defendants into the field as dealers in this class of electrical apparatus is recent and with notice of the claims of said patent; the trolley stands in suit are adapted only for electrical railways, and can only be used to effectuate the construction covered by the patent in suit; the advertisements contained no limitation to sales for repairs or to persons having the right to use the invention, and the court asserts that it may be fairly inferred from the affidavits that sales have been made to persons not having such right. The trolley stand is probably the most substantial, if not the chief, element in the patented combination; it does not appear that it wears out quickly or breaks frequently, as do poles, wheels and harps, other elements in said combinations.

The bill charges defendants with actual infringement and threats to infringe. Such infringements, if any, the court decides is contributory only, inasmuch as the defendant only deal in a part of the patented combination, contributory infringement being defined as "the intentional aiding of one person by another in the unlawful making or selling or using of the patented invention." The principal points in Judge Townsend's decision will be found in another column.

The scope and subject matter of the Van Depoele patented claim is contained in the following extracts from the patent:

"6. In an electric railway, the combination with a suitable track and a supply conductor suspended above the track of a car provided with a swinging arm carrying a contact device in its outer extremity and means for imparting upward pressure to the outer portion of the arm and contact to hold the latter in continuous working relation with the underside of the supply conductor substantially as described.

"7. In an electric railway, the combination of a car, a conductor suspended above the line of travel of the car, a swinging arm supported on top of the car, a contact device carried by one extremity of the arm and held thereby in contact with the under side of the electric conductor, and a tension device at or near the other end of the swinging arm for maintaining said upward contact substantially as described.

"8. In an electric railway, the combination of a car, a conductor suspended above the line of travel of the car, an arm pivotally supported on top of the car and provided at its outer end with a contact engaging the under side of the suspended conductor, and a tension spring at or near the inner end of the arm for maintaining said upward pressure contact, substantially as described.

"12. In an electric railway, the combination with a car, of a post extending upward therefrom and carrying a suitable bearing, an arm or lever carrying at its outer end a suitable contact-roller and pivotally supported in said bearing, and provided at its inner end with a tension spring for pressing the outer end of the lever carrying the contact wheel upward against a suitable suspended conductor, substantially as described.

"16. In an electric railway, the combination of a car, a conductor suspended above the line of travel of the car, an arm pivotally supported on top of the car and provided at its outer end with a grooved contact wheel engaging the under side of the suspended conductor, and a tension spring for maintaining an upward pressure contact with the conductor, substantially as described."

The Laval Steam Turbine.

In some French trials, a 50-hp Laval turbine was tested at a steam pressure of 71 pounds per square inch, and gave a consumption of 23.27 pounds steam per horse-power-hour. Two other trials, made at the Bordeaux Exhibition at full load (100 hp) for seven hours at a boiler-pressure of 113 pounds per square inch and a vacuum of 26 inches in the condenser, resulted in a consumption of 21 pounds of steam per horse-power hour. With a load of 50 hp there was a consumption of 23.27 pounds of steam. A third trial after nine months' use resulted in a consumption of 19.58 pounds per horse-power-hour on a 10-hour trial. A fourth test at Troyes on a 20-hp turbine driving shafting which drove four dynamos, gave a consumption of 19.58 pounds of steam, the pressure being 71 pounds per square inch. In a fifth trial made with a 75-hp turbine at the Magasins de la Place Clichy, with a steam pressure of 170 pounds per square inch and a 26-inch vacuum in the condenser, the water consumption was 23.1 pounds per horse-power hour. The consumption of steam on starting was 30 to 35 per cent. more than normal. In all cases the efficiency was greater with larger turbines, owing to the fact that the speed of the vanes was greater; in turbines of 200 horse-power this speed was 1300 feet per second, while in 75-hp turbines it was only 200 feet per second.

Stereoscopic Röntgen Pictures.

BY ELIHU THOMSON.

While experimenting with the making of shadow pictures, it occurred to the author that it would be desirable to secure some indication of the position in space of various embedded solid objects, or, in other words, to obtain a pair of pictures which, when placed in a stereoscope, would show solidity. This would manifestly be useful in surgical examinations, as the true relations in space of the parts of a bone, or of a foreign body, and the bone would become evident. The ordinary Röntgen pictures are simple shadows on a plane surface. It is impossible to tell from such a shadow whether one object or part of an object is front or back of another. There is, however, no difficulty in determining the real positions when resort is had to the production of stereoscopic shadow pictures.

The first trial made by the author was completely successful, objects appearing in high relief. The process consists simply in exposing a covered plate in the ordinary way and repeating this with the objects and Crookes tube relatively displaced somewhat from the first position. The rays thus pass through the objects in two somewhat different directions, a record of the shadows being made for each direction. Prints from the negatives so produced are mounted for use in the stereoscope. The effect is very curious. A cork or block of wood having nails or screws driven into it in various directions is clearly shown, and the screws or nails in their proper positions. When two heavily insulated wires twisted together constitute the object, the metal wires alone are seen, but standing apart in space, one around the other.

The bones of two superposed figures are to be seen in their correct positions. The complete skeleton of a mouse or other small animal may thus be recorded so as to be seen in relief, each bone in its proper space relation to the others.

It may be possible as a development of the use of Röntgen rays stereoscopically to arrange two fluorescent screens, or even a single screen, to be viewed by the eyes and receive the image or shadow in such manner as to produce the stereoscopic effect; thus, if the Crookes tube has two cathodes a distance apart, which are connected to the electric source alternately, and with considerable rapidity, while small shutters are synchronously opened and closed before each eye respectively, one of the eyes would at all times receive the impression given by the rays from one of the cathodes, while the other eye would always receive the impression produced by the rays from the other cathode, and thus stereoscopic observations would be the result. This method of producing the stereoscopic effect is similar to one which has been tried and used successfully in stereopticon work; two lanterns being arranged to throw upon the same screen in nearly superimposed positions two slides, which are stereoscopic in their relation to each other. A set of diaphragms were arranged, passing in front of the lantern tubes synchronously with similar diaphragms passing before the eyes of the spectators, whereby each eye always received its appropriate image on the screen, the result being to give solidity to the scene depicted.

Shadow Pictures.

BY W. H. FREEDMAN

The issue of The Electrical World of March 7 contains a short note by N. H. Daniels, Jr., in which he makes a statement regarding experiments carried on by the writer in regard to the filtration of light through solid bodies to the effect that since no explanation has been offered he concludes that the writer supposes the action must be due to the presence of Röntgen rays in sunlight. It is rather severe to be thus ruthlessly classed in the category of experimenters not able to interpret their results, and not to be given credit for even ordinary intelligence.

For the time being, the only facts that the writer feels called upon to present as a result of investigation begun with Mr. C. T. Rittenhouse, but since continued unaided, are the following:

On Feb. 6 an ordinary plate-holder having a rubber slide $\frac{35}{1000}$ of an inch thick and containing a sensitive plate was placed eight inches from an arc light. Fastened to the plate was a screw driver and a spectacle case containing a pair of eyeglasses. About half way between the arc and the plate-holder was placed a sheet of cardboard $\frac{31}{1000}$ of an inch thick to act as a screen shutting off the heat, and thus preventing the plate from melting.

After keeping the plate-holder in this position for five hours it was then developed, showing very plainly the shadows of the screw driver and the case. On testing the case it was found to be made of leather and cardboard. Under these circumstances the shadow pictures could only have been due to the filtration of light through the cardboard screen and hard rubber slide. For if Röntgen rays had been responsible for the action why did not the iron part of the screw driver inside of the wooden handle show? And why did not the eyeglasses inside of the case show?

Since the spectra of the arc and of the sun are very similar the thought was suggested to attempt to obtain a shadow picture from ordinary sunlight. Accordingly the next day, Feb. 7, a plate-holder, exactly similar to the one exposed to the arc, was placed in the sunlight and several pens, a penholder and an ink eraser were laid on the hard rubber slide. After an exposure of four and a half hours the shadows of the objects showed very plainly on developing the plate.

Further experiments to *prove* that these effects were not due to Röntgen rays consisted in employing a slide made from aluminum $\frac{1}{100}$ of an inch thick. This aluminum slide was cut from the same sheet of metal through which Dr. M. I. Pupin has obtained many fine skotographs. In not a single instance has the writer been able to obtain a shadow when this aluminum plate-holder was subjected to the action of the arc or sunlight even with exposures as long as seven hours.

If shadows were obtained through hard rubber or cardboard slides they were all about the same degree of density, wood and leather being as black as iron and steel. Futhermore, the glass cast absolutely no shadow.

Another interesting result was obtained from accidentally placing a number of plate-holders with hard rubber slides so that the light struck them at an acute angle. In no case was any shadow picture obtained, although all the conditions except that of position were identical with previous exposures. The explanation of this seems to lie in the fact that most of the light was reflected from the hard rubber slides and not enough filtered through to affect the film.

The writer possesses many more results which he asks permission to reserve until the investigation is finished, when they will be presented, if in his opinion they are deemed of sufficient importance.

Transformer Plates.*

BY GEORGE ADAMS.

Mr. Ernest Scott has somewhat unwarrantably assumed that I have fallen into the common error of supposing that the Mordey transformer is invariably built up as described in text books.

As a matter of fact, I saw "Mordey" transformers being built up in the orthodox text-book manner at the Brush Company's works at Loughborough, not more than a year ago.

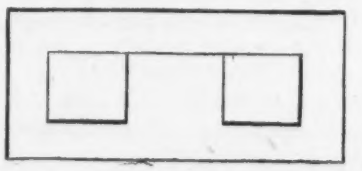
Since transformers of this type were actually made by the Brush Company until quite recently, they should be quite respectable transformers even from the practical man's point of view.

The type of plate described by Mr. Scott is not unknown to me, as I had ample opportunities of observing the construction of transformers built up in this manner at the Brush Company's works.

Although there is no waste of iron in the Mordey transformer described by Mr. Scott, there is very little to commend this method of construction; in the first place there is a multiplicity of parts, there being no less than four differently shaped stampings.

Mr. Mordey evidently believes in providing the maximum number of air-gaps, each of which tends to increase the no-load current; while he has, I believe, always advocated a short magnetic circuit with the avowed object of diminishing the no-load current, an apparent inconsistency. With so large a number of loose plates to manipulate it is a matter of great difficulty for a workman to ensure the stampings being properly butted together so as to form a good iron circuit.

It is possible to use a plate with one split only, as shown in the sketch below, the centre portion being bent back to pass the coils. It



is difficult to conceive a transformer with a more efficient magnetic circuit than this, especially if alternate plates are arranged to break joint, and the whole is firmly clamped together.

* From the London *Electrical Review*. See also The Electrical World of Jan. 11 and Feb. 29, 1896.

Experiments with Röntgen Rays.

BY ALEXANDER MACFARLANE.

During the past 10 days experiments on Röntgen's rays have been made in the electrical laboratory of Lehigh University under my direction, with the assistance of Instructors Klinck, Webb and Clark. After we had taken good radiographs of the hand and of a sunfish we felt sure of the method and proceeded to test the physical properties of the rays. We used an induction coil and a Crookes tube of cylindrical shape with approximately hemispherical ends. In each end there is a platinum wire to serve as an anode. The cathode is a metal disc placed in the centre, transverse to the tube and of nearly the same diameter. The length of the tube is 10 inches, and its diameter 1½. When both anodes are connected to the terminal of the coil there is a dark space on each side of the cathode and only the hemispherical ends are fluorescent; but when only one anode is connected, only its end of the tube appears fluorescent. In the course of our preliminary trials we observed that solid paraffin is very transparent; also that the designs, both on the obverse and the reverse of an aluminum medal, were reproduced.

To test the source and manner of propagation of the rays the following experiments were made. Thin nails, one inch long, were driven vertically into a half-inch block of wood so as to form regular rows and columns, and they were all driven in so that their points just pierced through the wood. The block of wood with the nails was placed in the slide of the plate-holder, and the Crookes tube was placed perpendicular to the block and at a distance of four inches from it. As a result, the photographic plate shows a single shadow for each nail; right opposite the axis of the tube there is merely a dot, but out from the axis the shadows are like comets, the further out the longer the tails; and all these comets point straight at the dot in the centre. It reminds one of the radiant point of a shower of meteors, only here the meteors are all heading toward, not from, the centre.

We next investigated the direction of the rays at the side of the tube. The block of wood with the nails was placed at the side of the tube, at a distance of four inches, and equally distant from the two ends of the tube. In the first case, both ends of the tube were excited. As a result, each nail produced two shadows; at the middle, opposite the cathode, the shadows were equal in intensity and length, at either end they were unequal, the short, intense ones pointing to the near end of the tube, and the long, dim ones pointing to the further end. The two systems of shadows indicate clearly that the rays do not radiate from the tube as a whole, but that they radiate only from

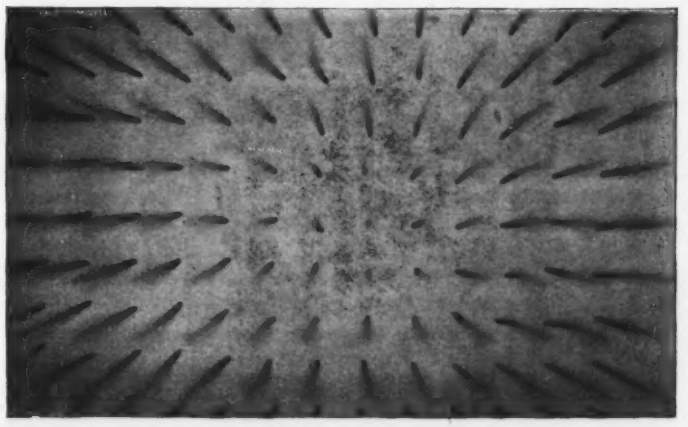


FIG. 1.—SINGLE SHADOWS.

the ends, where also the fluorescence is. They indicate clearly that the ends of the tube were the sources of the rays. To confirm this view, a radiograph was taken, with the block of wood placed alongside the tube as before, but with only one anode connected to the coil. There was then only one system of shadows, and they pointed directly at the fluorescent end of the tube.

An examination of the two shadows of a nail, produced when the nail is between the two excited ends, shows how the exact location of the nail may be deduced. The point of the nail was separated by the slide from the sensitized surface, consequently the two shadows do not meet; but if they are prolonged, the point of intersection gives the true position of the nail. This indicates how best to use two radiant sources when a search for an embedded bullet or needle is made by means of the radiograph. Some experimenters have been puzzled by the appearance of "secondary images" in their radiographs; the reason for their appearance is that the plate was exposed to two distinct centres of radiation, like the two ends of our tube. Knowing exactly the nature of the source of radiation used, it was possible to test accurately whether the rays are refracted when they pass obliquely from the air into another medium. Prisms of paraffin and of wood were placed on the slide of the plate-holder, and needles placed so as to be supported by the prisms and project into the air; the tube was placed perpendicular to the plate and at four inches from it. The shadows of the needles were straight lines.

FIG. 2.—DOUBLE SHADOWS.

Had the rays which passed through the prism been bent the shadow through the prism would not be in line with the shadow through the air. Some experimenters have announced that they have obtained two shadows produced by one object, when the rays passed through Iceland spar. The doubleness of the image was no doubt due to the existence of two distinct sources of radiation.

We tested whether the Röntgen rays can be reflected in the following manner: A small plate of copper was placed near one end of the Crookes tube, and the disc of nails was placed over a sensitized plate in a position where it could not receive the direct rays from the radiant end, but would receive rays reflected from the copper plate if such existed. A similar arrangement was made at the other end of the tube, only a plate of wood was used instead of the plate of copper as a possible reflector. No trace of an effect was obtained on either sensitive plate.

We also tested whether the temperature of a metal affected its opacity to the Röntgen rays. Two equal iron wires and two equal platinum wires were stretched across the holder; one of each kind was kept red hot by means of an electric current. No difference in the shadows thrown by the hot wire and the cold wire could be detected in either case.

Information Wanted Regarding X Raise.

THE ELECTRICAL WORLD has received the following interesting letter to be forwarded to Prof. Röntgen, which it takes the liberty of sending in this manner, as the professor's mail must be very large at the present time:

PROF. RÖNTGEN,

My Dear Professor:—I have been greatly interested in your discovery, and congratulate you on having jumped Edison's claim of being the only original Wizard (of the Nile). Your discovery is very interesting from a scientific point of view, but will you be kind enough to tell me if I can apply it so as to get an "X raise" out of my boss? As I am the humble recipient of the magnificent salary of $9.50 per week, even a V raise would be most acceptable, but I do not know how to apply the process to him.

Shall I induce an "electrical resistance" on the part of the office cat to having her tail squeezed in the letter press by the errand boy, then continue to cause a "current" of envy in the entry clerk by flirting with the typewriter girl to prevent her from "sparking"? I could give the bookkeeper a "laden-jar" on the elbow while he is writing in his ledger, and then cause a "vacuum" by handing in my resignation. Would it work? I am afraid I might get an "electrical discharge." Please give exact directions in your reply.

Röntgen Radiographs.

Mr. J. S. Stokes and Mr. M. E. Leeds, of Queen & Co., Philadelphia, have taken a number of successful radiographs with Crookes tubes made by their firm. One of these we illustrate in Fig. 1, being a picture of a pocket book containing two coins and a key, which, as will be seen, are extremely sharp in outline.

Fig. 2 is a reproduction of a radiograph taken in the laboratory of Prof. A. F. McKissick, at the Alabama Polytechnic Institute. In this case, a Tesla coil capable of giving a seven-inch spark was used in connection with a Crookes tube, of soft German glass; this tube gives a phosphorescence of a bright apple-green color. The exposure was 30 minutes. Among the objects shown in the illustration are a circular piece of very thick brass, a pencil with a metallic tip and an iron hook. These articles were placed directly on the plate-holder with nothing between them and the tube. In the upper right-hand corner is shown a piece of glass which was placed on the plate-holder and covered with a note book. In the lower half is a transformer plate of thin iron which was covered with a piece of pine board one and three eight inches thick.

During some experiments made in this laboratory a rather remarkable result was obtained while making a radiograph. A plate-holder with some articles on top of it was being exposed to the influence of Röntgen rays, when one of the connecting wires within the tube was accidently disconnected, causing a succession of sparks from the end of the wire to the tube terminal. Upon the plate being developed a peculiar and intense arc-shaped image appeared at once; later on a faint outline of the articles exposed showed on the negative, but not on the print. The arc in the print is extremely clearly defined, and extends almost entirely across the print; it is of considerable width and of a curiously corrugated or roughened outline.

Prof. Lispenard Robb, of Trinity College, last week found that a genuine diamond offers little resistance to the Röntgen rays, casting not more of a shadow on the photographic plate than wood or flesh or other substances easily penetrated by the rays, while an imitation diamond, on the contrary, casts a solid block of black, more intense even than the metal setting.

At a meeting of the Royal Society, on Feb. 13, Capt. Abney expressed a doubt as to whether the action of Röntgen rays on a sensitive plate could properly be described as photographic. He cited several facts which, in his opinion, excluded the theory of direct photographic action in any ordinary sense, and indicated some

Fig. 1.—Radiograph of Purse and Contents.

preferences for the view that the Röntgen rays acted by first setting up fluorescence in the glass at the back of the sensitive plate. This view was corroborated in some experiments by Prof. Dewar upon platina cyanide of ammonium at low temperatures. This salt ordinarily fluorescent only became phosphorescent at the temperature of liquid air. While being exposed to Röntgen rays instead of the ordinary light, while immersed in liquid air it showed brilliant phosphorescence when the liquid air was poured off. This proved that whatever might be the nature of the Röntgen rays, they are easily convertible into light rays affecting the human eye. Prof. Dewar described a large number of experiments showing that resistance to the discharge of Röntgen rays increases with the increase of atomic weight. The views of Capt. Abney were received with some dissent.

Mr. Ralph R. Lawrence, of the Massachusetts Institute of Tech-

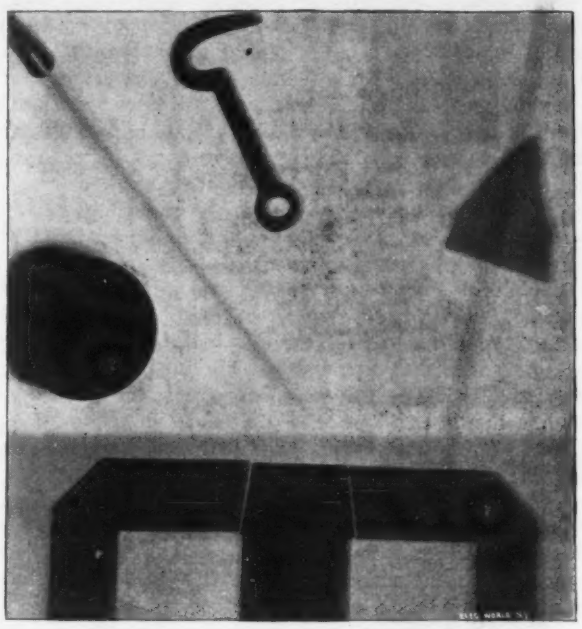


Fig. 2.—Radiograph of Pencil and Other Objects.

nology, writes to *Science* that some experiments made by him appear to indicate that nearly if not all Röntgen rays proceed directly from the electrodes of the tube, and not from the glass where this is acted upon by the cathode rays. Observations had shown that photographic effects were produced equally whether cathode rays impinged upon the glass or upon other phosphorescent material within the tube, such as arragonite.

Prof. W. S. Franklin gives an account in the same journal of some experiments made with a view to determining whether Röntgen rays proceed from the electric arc. His conclusions from the experiments are that Röntgen rays are not given off in abundance by the electric arc, and that they are not of the same nature as the ultra-violet in the spectrum, or at least that they are not of the same nature as the ultra-violet which is present in any abundance in the light emitted by the electric arc between carbon electrodes or between zinc electrodes. He states that in demonstrating the presence of Röntgen rays, it is necessary in every case to exercise the greatest care in the rigid exclusion of every other agent capable of affecting the sensitive plate, such as ordinary and ultra-violet light, electric charge acting directly on the film, mechanical pressure, high temperature, etc.

Prof. H. A. Rowland concludes from experimental investigation that Röntgen rays proceed not from the cathode, but from the anode.

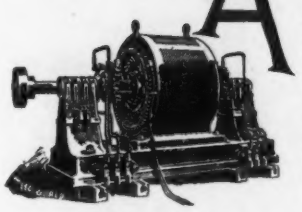
Hochspannungsakkumulatorenbatterie.

The above is another little German gem, which we notice in a contemporary. To solve it, it must be taken in installments; the real beginning is near the end, and the real end is the beginning, but this rule is not followed strictly, for, if it were, it might be more convenient to read it by means of a mirror. Begin near the end, then start again near the middle, and continue this oscillating process until all the letters and syllables have been interpreted, being careful to get the right combination. The interesting part of the solution is to find the correct separation between the individual words, which are not separated by hyphens, presumably to save trouble (in writing, not in reading). For instance, this word has nothing to do with the following words, although they form parts of it: Ochs (German for ox), span, pan, sak, oren (German for ears), renn (running), bat, batter or Erie, although these words taken together might suggest an interesting little story. The correct solution is as follows: a battery of accumulators whose voltage is high.

Central Station Working—XI.

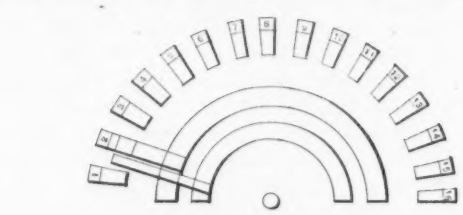
A CENTRAL STATION PROBLEM.

BY C. R. VAN TRUMP.



AN axiom that applies particularly to central station operation is that what is good engineering for one case may be very doubtful in another. Probably we may never be so fortunate as to outlive all the errors of commission or omission which are to be met with each day in central station practice, and the greatest errors are sometimes justified by the best practice of the day. Indeed, there is no type of apparatus and no method of operation which may be said to fulfill all the requirements. For instance, the central station of which the writer is in charge, and with which this paper deals, stands at or near the centre of distribution of a low-tension, three-wire system which forms three fourths of the total output, about 600 kilowatts. Being one of the earlier plants, it is supplied with high-speed, non-condensing apparatus, and the haulage of coal amounts to 10 per cent. of the cost of the fuel on tracks. And yet the economy has not been very apparent in favor of moving the generating plant a distance of less than 2000 feet, in order to get water for condensation and fuel on a railway siding alongside fire-room, even with the use of modern steam apparatus. Although this would not seem self evident, yet when we consider that though we might hope to save about 40 per cent. in fuel, this item is less than 50 per cent. of the cost of current, and only 30 per cent. in our station, as we consider that our produce is *electric service*, not electric *current*. We would only gain 40 per cent. of 30 per cent., or about 12 per cent. saving, while the outlay would be about 5 or 6 per cent. of the cost of the current in additional interest, renewals, etc., and the electrical loss would be nearly as much more, leaving a small margin which would hardly pay. Of course, the case would be altered if an entirely new plant were considered.

But another method of getting far better results has been adopted



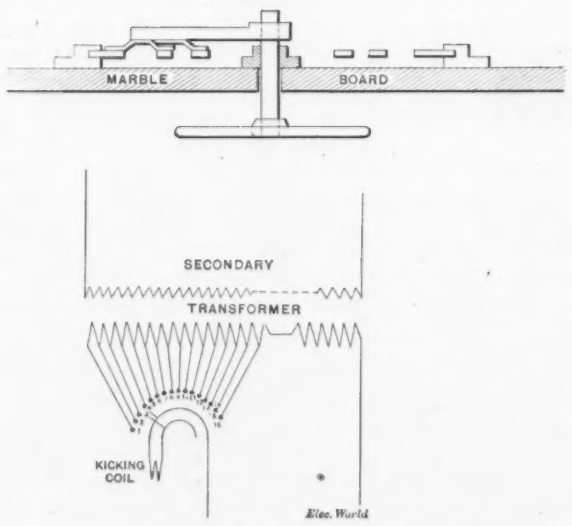


FIG. 2.—REGULATOR AND CONNECTIONS.

which may prove of interest or practical value to other stations. It is often the case, especially in manufacturing districts, that large amounts of power are used with very poor economy; in fact, enormous wastes are not uncommon, especially in the case of water-powers which are used in the daytime and at night are allowed to waste over the dam breast. The plan adopted by the writer has been to contract for this waste power, put in apparatus in the mills of the concern, and transmit all that could be spared to the centre of distribution, the power being bought on a meter basis and distributing on the present system. The mill owners receive a revenue from this waste which amply pays them; the central station receives the power at lower cost than the ideal plant would produce it, and at very low outlay.

This central station carries a load on a three-wire direct-current system of about 600 kilowatts, covering a territory three fourths of a mile radius from the station, and a single-phase alternating 125-cycle system load of 130 kilowatts at 1200 volts, covering a territory outside of the direct-current system of three and one half miles radius, including suburban districts for incandescent work; and finally a constant-current arc load of 150 lights. In the question of economy, the high-tension plants were of first importance, as greater economy was possible with the direct-current apparatus. A substation with better economy was deemed inexpedient for these sys-

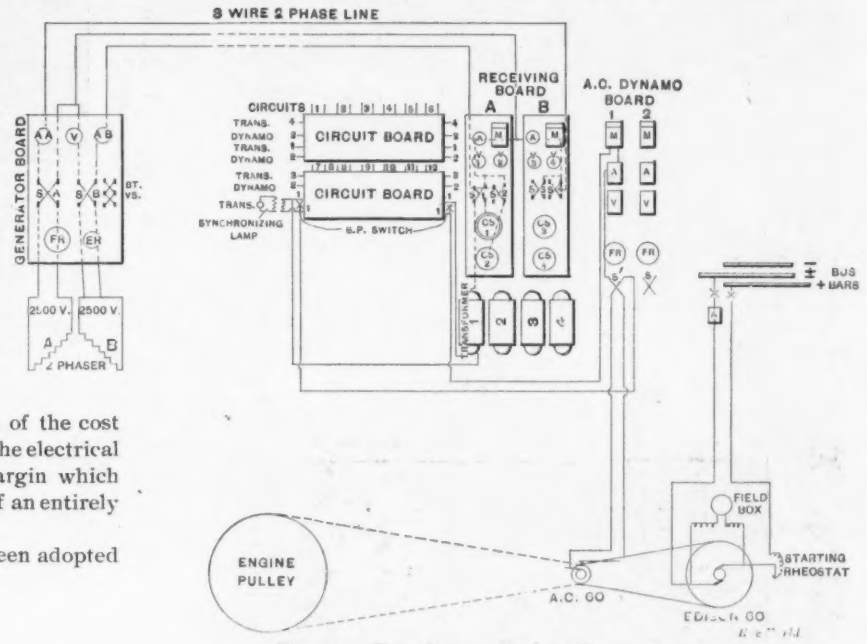


FIG. 1.—TWO-PHASE PLANT CONNECTIONS.

tems alone, as this would divide up the plant to no advantage in operating expense.

A proposition was made to a large cotton mill and dyeing concern near the town to sell current to the central station. The mechanical head of this concern, who, although not figuring as blasé in the engineering world, is nevertheless one of the best posted and deepest thinkers the profession can boast. He considered our proposition with great care. Their conditions were favorable, for besides a large water-power, much in excess of their demands after the hours of operation during the day, they use a large amount of steam for heating purposes at 30 pounds pressure. They had engines and boilers in reserve, which they operated at 110 pounds pressure, and it is very easy to see under such conditions that a simple engine operated at 110 pounds could be exhausting into the low-pressure mains at 30 pounds back pressure, with the excess cost of steam at 110 pounds over 30 pounds, or at less cost than the ideal station with the latest and largest equipment could possibly produce the power. This is apparent, since a pound of coal is capable of giving about 11,500 B.T.U. to the water in a good steam boiler, and at 30 pounds pressure, 1165 B.T.U. per pound are in the steam, and only 22 more, or 1187 B.T.U. per pound, are needed to produce 110 pounds steam pressure, while 1146, or 19 less, are still in the steam at atmospheric pressure exhausted from a non-condensing engine. Therefore, if in steam at 30 pounds pressure 22 B.T.U. are added per pound of steam, one pound coal would raise 520 pounds of steam from 30 pounds to 110 pounds or produce from 10 to 15 horse-power on one pound of coal.

The plans were to meet the following conditions: Their water-power was ample to supply 180 kilowatts, and in the daytime the steam power available under 30 pounds pressure (their demand for steam being otherwise supplied by a low-pressure bank of boilers) was equal to this. The A. C. load at dark became 150 kilowatts and dropped off at midnight to 75 kilowatts, supplying principally an incandescent municipal service. All the A. C. apparatus was built

for 125 cycles; the distance from the station to the mills was 12,600 feet; the attendants could not be relied upon for constant attention, although the speed curve showed close regulation of the power. Electrical power was also a necessary feature, both for the station and the mills. No spare electrical apparatus was to be provided, which necessitated keeping the old plant intact. The day load was exclusively direct low-tension current work.

The plant installed (Fig. 1) to meet these conditions was as follows: A Stanley-Kelly two-phase machine of 180-kw capacity, and 125 cycles, was belted direct to a jack-shaft with clutches so that it could be driven from either water-wheel or one of two engines. The line consisted of 12,600 feet of three No. 00 B. & S. weather-proof conductors (providing for future increase), with square yellow pine poles, 5-feet cross-arms and triple petticoat glass insulators, built to carry the current to the receiving board. Four special step-down transformers, 2500 to 1200 volts, were put on each side of the system; one side of the primary of each transformer was connected through the commutating switch as shown in Figs. 3 and 4 in detail, with a kicking coil to prevent short-circuiting, and with 15 terminals on the primary coil of the transformer; thus, with the switch on the first point, with 2500 volts on the primary, 1175 volts were available on the secondary of the transformers, while on the last point, with 2500 volts on the primary, 1325 volts were available. Ten volts between each point of the commutating switch admitted of varying the pressure on either of the four transformers without a loss or leakage through additional primary coils. The secondaries of the transformers were connected as indicated to transformers Nos. 1, 2, 3 and 4, to points Nos. 1, 2, 3 and 4 on each side of the old circuit board, these boards being cross-connected by means of plugs and double-throw switches, carrying 12 circuits, so that any circuit could be thrown on either of two of the transformers connected to one of the boards, one on each side of the system, and the load thus perfectly balanced if desired.

Two of the single-phase machines were each placed in line with two 60-kw direct-current Edison generators, driven from a single

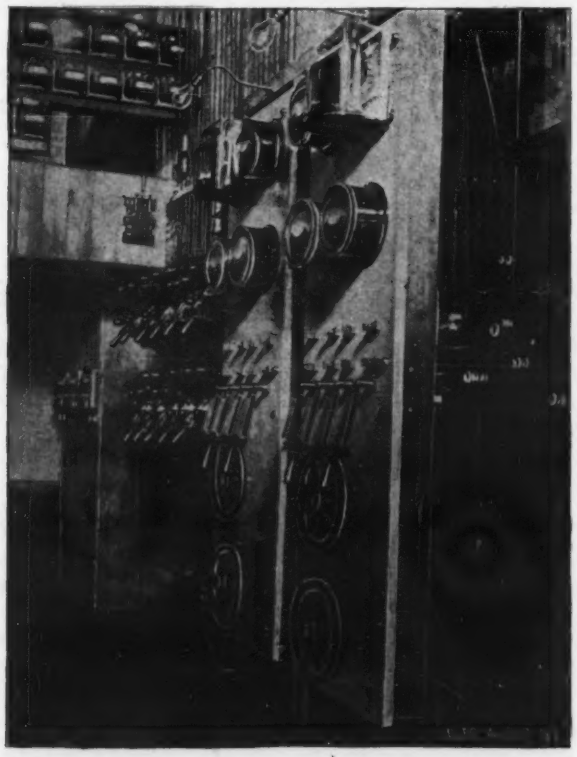


Fig. 3.—Receiving Board, Two-Phase System.

expansion engine, so that the belts could be removed from the Edison dynamos and the alternators belted direct to the engine in case they were needed, or the A. C. 60's could be run as synchronous motors driving the Edison 60's in the following manner: A rheostat was placed in the armature circuit of the direct-current dynamo so that it could be started as a motor; short belts were provided to connect the Edison machines with the alternators, and at the board switches were arranged so that either alternators could be thrown into multiple with one of the transformers on each phase, as shown in Fig. 1, for No. 1 alternator and No. 1 transformer.

The Edison dynamos are started as motors, bringing the A. C. 60's up to speed; a small converter and pilot lamp are connected across one of the single pole switches for synchronising. By this arrangement the alternators are brought up to speed by the Edison machines running as motors; the resistance in the armature circuit is thrown out, and the speed varied by the field box of the Edison

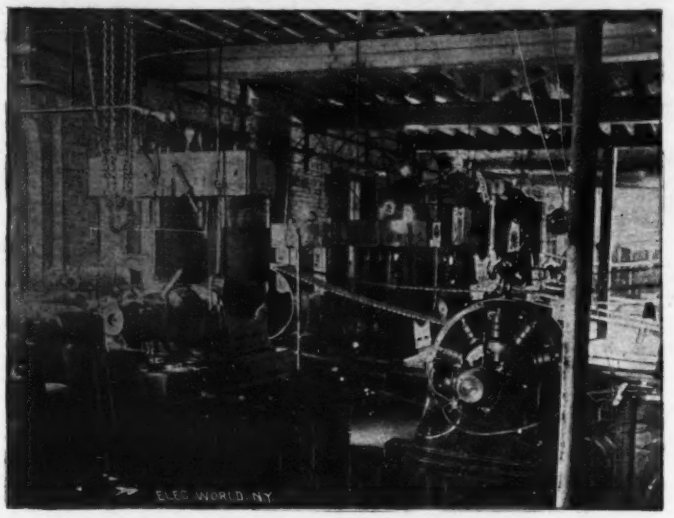


Fig. 4.—Alternator as Synchronous Motor Driving Edison Dynamo.

machines, the voltage of the alternators being varied by the field rheostat until it is equal to that of the transformers, one side of the alternator being connected to the transformer. The pilot lamp flashes as the machine goes in and out of synchronism, and when the speed is adjusted until synchronism is nearly reached, the pilot lamp goes out; the remaining switch connecting the alternator in multiple with the secondary of the transformer is then thrown, the field box of the direct-current machines is thrown out, and the load is taken by the latter on the three-wire system, the generators driving them as synchronous motors. This operation is performed every day without difficulty, the Edison machines after being thrown taking the load easily and smoothly. No induction losses occur on the lines; in fact, as the field excitation of the alternators is increased the machines kick back on the line exactly like a condenser in circuit, counteracting any inductive effect of the line.

By this means, after the alternating-current load drops off at midnight, the synchronous motors driving the 60-kw direct-current machines on the three-wire system, are thrown in and carry the load, from 75 kilowatts on circuit board to which it drops at midnight, up to 175 kilowatts, the steam plant then being shut down.

The plant has been in operation for the past four months with excellent results except a scarcity of water from the excessive drought, the water having until lately run lower than for many years. The only difficulty in operating is during the time the mill machinery and dynamos are both on the water-wheel, which necessitates extreme care in avoiding rapid fluctuations of load. The load is thrown on very slowly and taken off with the same care, as a rapid drop in load on the dynamos tends to make the water-wheel race with its sluggish governor.

Curious Blunders.

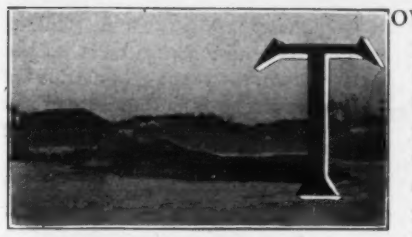
A curious error occurs in Mr. Park Benjamin's work on "The Intellectual Rise in Electricity." An experimenter is stated to have "held his *wife* in his left hand and felt a smart shock the instant the circuit was closed." Sir Henry Roscoe's recently published "Life of Dalton" recounts a delicious answer of one of Dalton's pupils when asked to describe Dalton's atomic theory. It consists, he said, of cubical-shaped pieces of wood painted various colors.—London *Electrical Review*.

Quality, Price, and Reputation.

There is at present great complaint in England against the introduction of the cheap and poor German incandescent lamps. In connection with this, some one in England recently suggested that the only safeguard is to persuade people to buy the more expensive lamps. We would suggest that the natural result of this would be that the German makers will raise the price of their poor lamps. This is a method adopted by some manufacturers (cigarmakers, for instance), who desire to cater to those who think that the most expensive is necessarily the best. After all, the best guide is a good reputation.

A Cotton Mill Electrical Transmission Plant.

BY A. F. McKISSICK.



TOWARD the middle of the year 1894 the Pelzer Manufacturing Co., of Pelzer, S. C., decided to increase its plant by the addition of a new mill (No. 4), and to develop for the use of this mill a water power owned by the company, located about two miles farther down the river on which Mills Nos. 1, 2 and 3 are located. After considering the many advantages offered by electrical transmission, it was decided to adopt that system, and the following October the contract for the entire electric equipment was awarded to the General Electric Company. This equipment consists of three 1000-hp generators (three-phase), of 3300 volts each, all station apparatus, a line 2⅝ miles in length, 21 induction motors of various sizes, all necessary transformers, switches, lightning arresters, 1200 incandescent lamps for lighting the new mill, two 5-hp pump motors and one 400-hp synchronous motor for operating Mill No. 3, replacing therewith a 400-hp Harris-Corliss engine.

The work of installation of this plant is at this date very nearly completed. Some of the motors have been in operation since Dec. 22, 1895, and at this date about half the motors are being used continuously at the new mill.

Beginning the description of the plant at the dam, the initial cut gives a very good view of the same, with the power-house on the left. This dam is built of solid masonry, has a 34-foot fall and a capacity of 5500 horse-power. Fig. 1 shows an interior view of the power-house, which is constructed of brick and stone. At present there are installed three 1000-hp three-phase generators of 3300 volts, direct coupled to Victor horizontal turbines, revolving at a speed of 167 revolutions per minute. The casings and all necessary tubings for two more turbines have been installed, with a view to increasing the capacity of the plant in the future to the total capacity of the water power. Figs. 2, 3 and 4 show the plans and elevations of the power-house. Fig. 5 gives a view of the switchboard, which is located in the gallery. The three generators are connected to the bus-bars on the switchboard, from which are led direct without the intervention of transformers the line wires, consisting of 18 No. 00 bare copper conductors. Carpenter enamel rheostats and Weston measuring instruments are used on this board.

A view of the line is shown in Fig. 6, which was taken just above the power-house. The poles are all of cedar, 40 feet high, well pointed at the top. On the upper cross-arm are strung two "buckthorn" wires for the protection of the circuits from lightning. These wires are connected together and grounded about every third pole, according to the location. The length of this pole line is two and five eighth miles. On the next three cross-arms are strung the 18 copper conductors, six on each cross-arm, all of the same polarity. On the lower cross-arm are strung the pressure wires and the telephone wires. A specially constructed large glass insulator is used on this pole line. At a point about three quarters of a mile from Mill No. 4 branch wires (No. 4 B. & S.) are led to the synchronous motor which operates Mill No. 3. At this point, where the wires branch to Mill No. 3, all the conductors of the same polarity are bonded together.

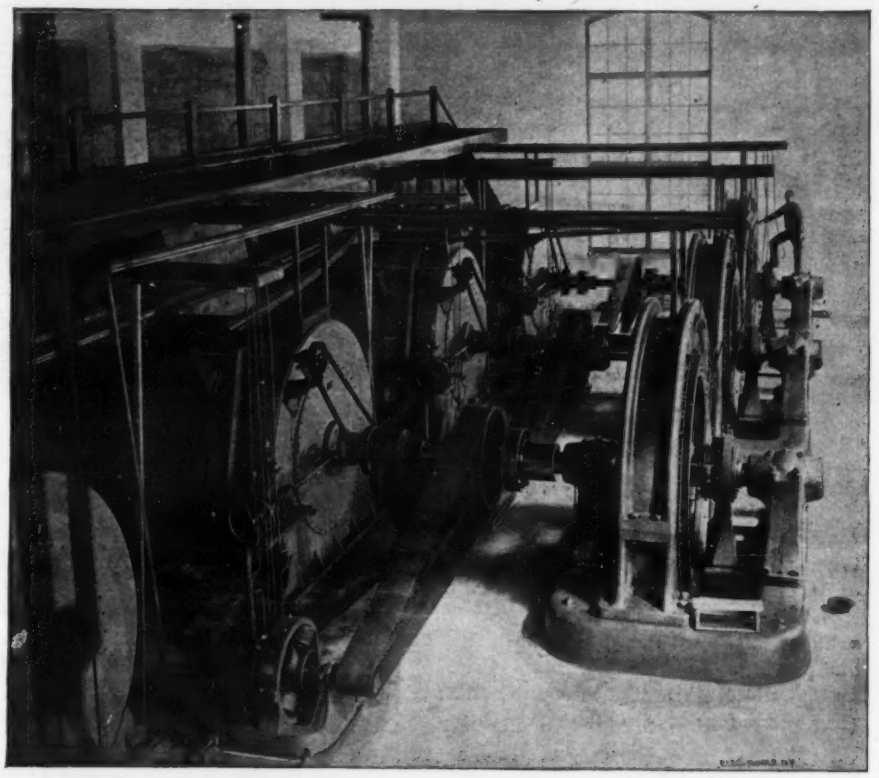


FIG. 1.—GENERATOR ROOM.

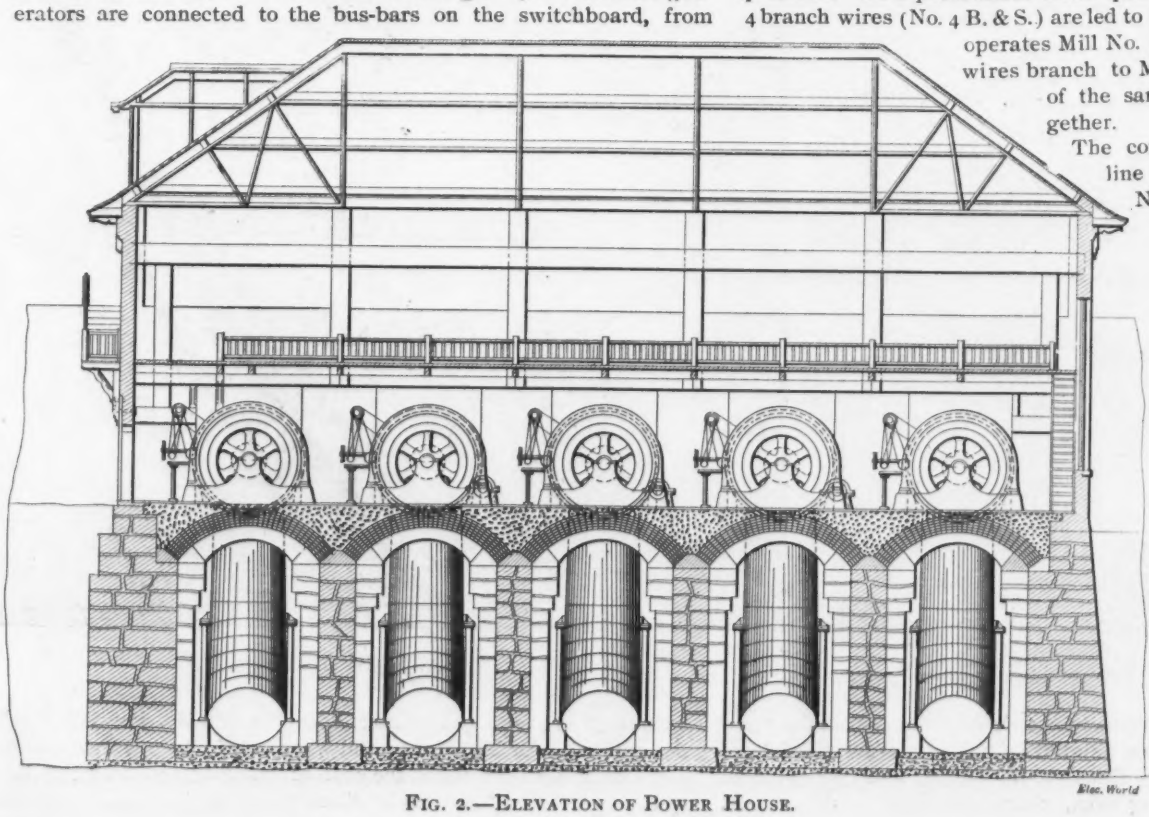


FIG. 2.—ELEVATION OF POWER HOUSE.

The conductors at the end of the line lead into a tower, of Mill No. 4, and from this tower go to the transformer room in the basement of the mill, through an underground tunnel. In this tower are located the lightning arresters, which are of the "G. E. type L, Form A." This mill is 506 feet long and 128 feet wide, four stories high, and has a floor space of seven acres, approximately. It is the largest cotton mill in the South, and is among the largest mills in the world under one roof. It has a capacity of 55,027 spindles and 1400 looms, and will manufacture a fine grade of cloth.

In the transformer room are located the transformers, all switches and other switchboard apparatus. The transformers are artificially cooled by an air-blast from two blowers, operated by two 5-hp motors. The motors on the different floors are supplied with current at a pressure of 200 volts, and are of the three-phase induction type, with no sliding contacts of any kind. These motors are bolted to the ceiling, thus saving much valuable floor space.

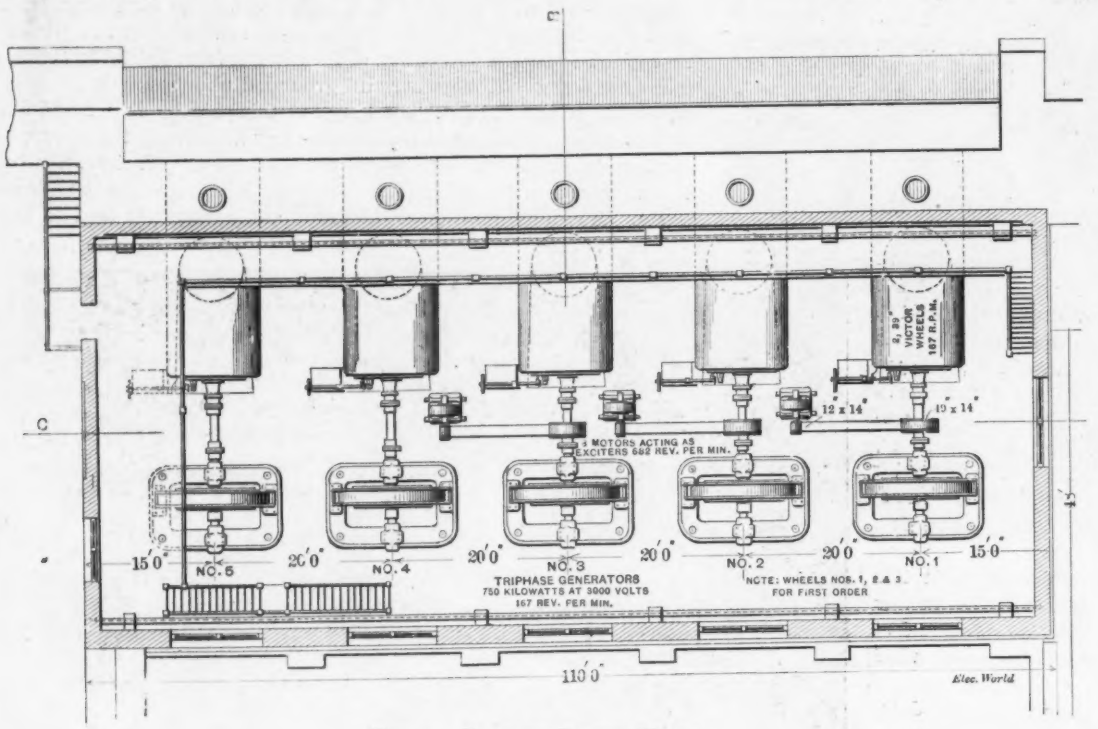


Fig. 3.—Plan of Power House.

In the basement there are two 50-hp motors operating the blowers, exhaust fans, repair shop, etc. The first floor is devoted to weaving and picking. In the picker room (Fig. 8) are located four 75-hp motors, direct connected to counter shafts, and in the weaving room (Fig. 9) are four 110-hp motors, operating 720 looms on this floor and 680 on the second floor, there being also on the second floor five slashers. The carding room (Fig. 7) is located on the third floor, requiring for its operation three 110-hp motors, and on the fourth story, which is the spinning room, there are eight 110-hp motors (Fig. 10). The same plant also furnishes current for 1200 incandescent lamps for lighting this mill, and current for operating two 5-hp motors for driving pumps.

The guaranteed efficiency of this plant, from the turbine shaft to the motor shaft, is 80 per cent. and the regulation of the motors is guaranteed not to exceed a variation in speed of 2 per cent.

In inspecting this mill, there are three facts which appear very striking to an engineer: First, that the largest belt in this mill, where 2000 net horse-power are utilized, is only eight inches wide; second, that the largest pulley is only thirty inches in diameter; third, that there are in this mill over a score of independent sources of power, thus doing away with long lines of shafting and long, heavy belts.

This company undoubtedly adopted the best plan when they decided to use electrical transmission. After it had been determined to build this new mill and to utilize for its operation the water power below the other mills, there were two methods of attaining this end possible, and to choose the most practical and the most economical was the problem. These methods were: First, to locate the mill near the water power and use direct belt or rope transmission and second, to use electrical transmission, placing the mill in a convenient location and one that did not require excessive excavations. If the first method had been chosen, the extra expense necessary for the excavations and foundations for this mill would have equalled two thirds of the cost of the whole electrical equipment, including the 400-hp synchronous motor for Mill No. 3 and the lighting apparatus for Mill No. 4; and when to this cost of foundations and excavations are added the cost of building and maintaining a spur from the railroad about three miles long, we can see that in

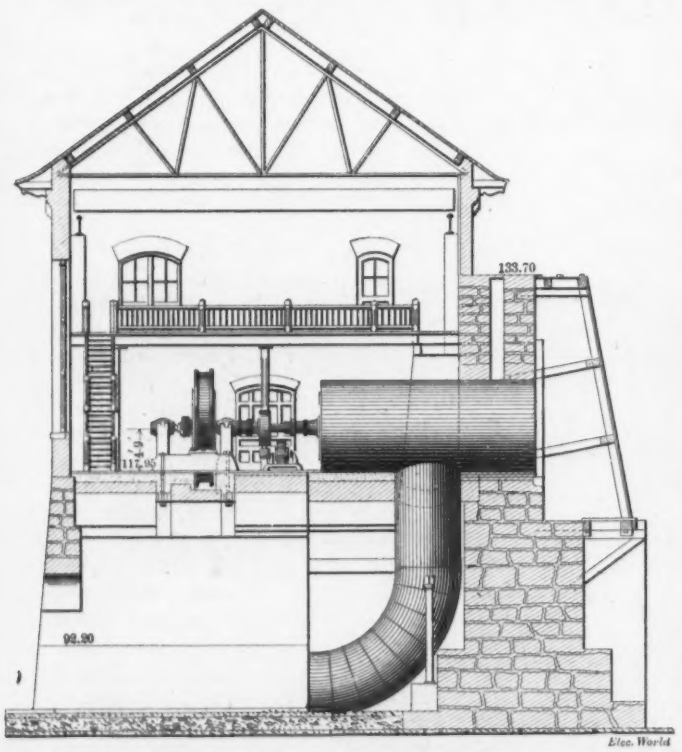


Fig. 4.—End Elevation of Power House.

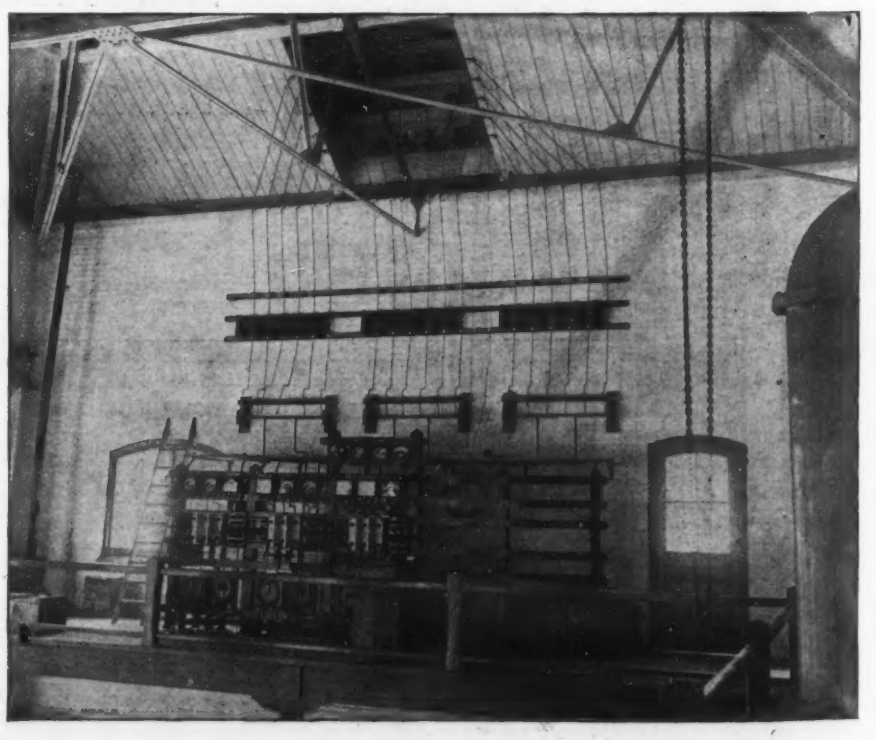


Fig. 5.—Switchboard.

point of first cost, the mill where it is now located cost practically the same as it would have cost had it been situated at the water

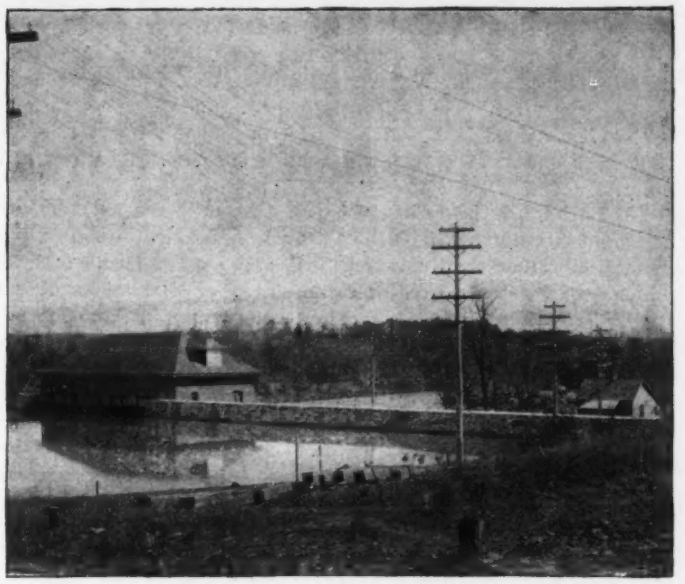


FIG. 6.—POLE LINE.

power. By placing the mill where it is now located, the following advantages are obtained:

First: Proximity to the other mills, thus saving duplication of mill offices, stores, churches, school houses and other mill village necessities.

Second: The choice of the location of the mill, as in this case it is located in what is practically a level field, in close proximity to the railway and near the other mills.

Third: The saving of the annual consumption of 2500 tons of coal, costing approximately $9000, by the substitution of a motor for the engine in Mill No. 3.

As an example of the transmission and the proper sub division of power, the Pelzer plant stands most certainly very high. Much credit is due for this radical departure in mill work to the officers of the company, Capt. E. A. Smyth, president and treasurer; Mr. A. L. Blake, secretary, and Mr. B. F. Guy, superintendent, and to Messrs. Lockwood, Greene & Co., of Boston, mill engineers and architects, who designed the plant.

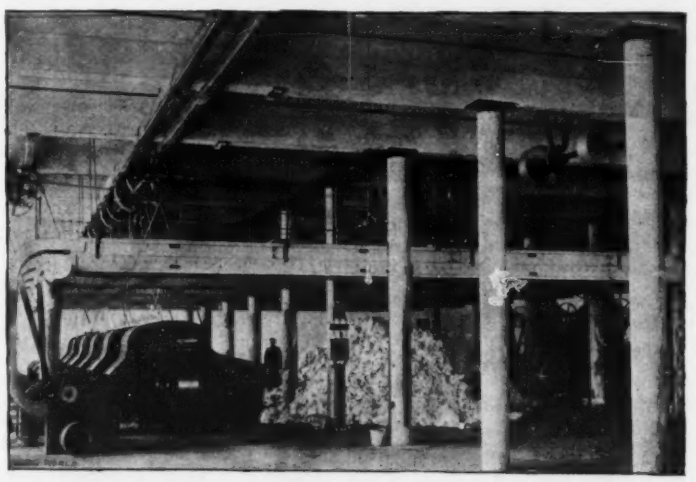


FIG. 8.—PICKER ROOM.

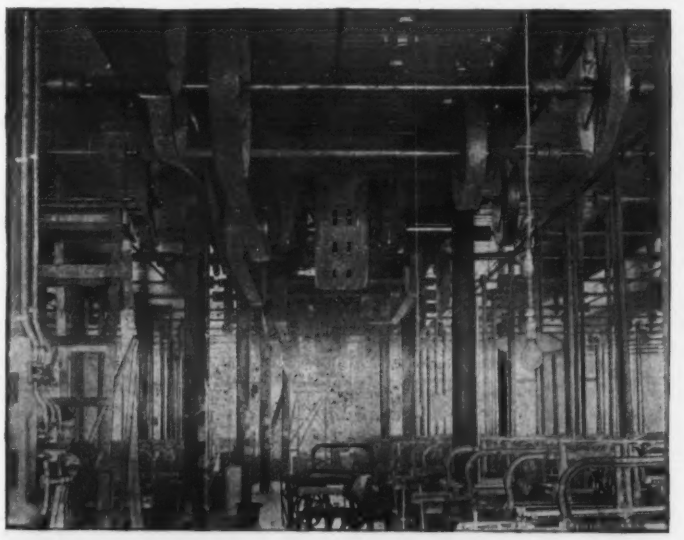


FIG. 9.—WEAVING ROOM.

A French Central Station.

The central station of the Société du Secteur Electrique de la Rive Gauche commenced operations the beginning of January.

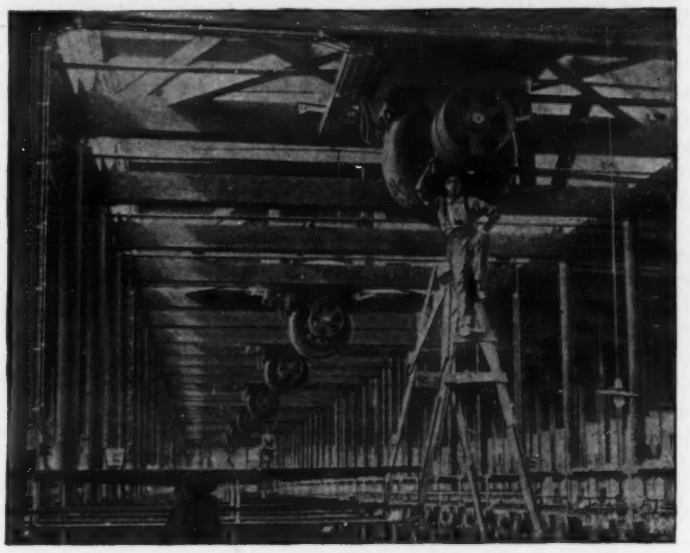


FIG. 7.—CARDING ROOM.

The station is situated outside the walls of Paris, at Issy, on the banks of the Seine, the current being carried into Paris by two feeders of 200 mm². These feeders divide at the junction of Boulevard du Montparnasse and Boulevard des Invalides, joining again at the junction of Boulevard St. Michel and Boulevard St. Germain. The cables carry a current of 3000 volts alternating, and are placed in direct contact with the earth. In the station there are three compound steam engines of 700 horse-power each and 125 revolutions per minute. To each engine and between the two cylinders a Ganz alternator is direct-connected. Each alternator is of 400 kw at 300 volts and a frequency of 42 periods per second. In time there will be 10 alternators similar to these.

The current is transformed to 110 volts by transformers in the houses of the larger consumers, the apparatus being in a closed room. There are besides four transformer sub-stations from which are led bare secondary cables resting on porcelain insulators in cement conduits underneath the sidewalk.

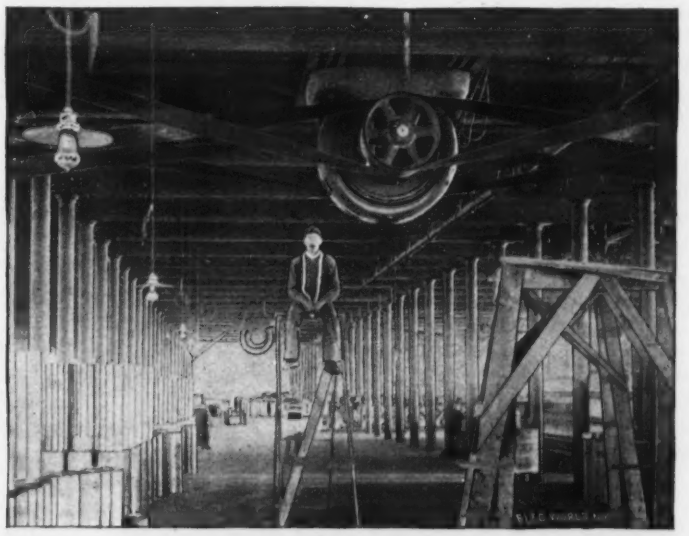


FIG. 10.—SPINNING ROOM.

Cold Light.

BY W. M. STINE.

In looking over the field of probable advancement in applied science, two modes are discerned in which prophetic opinions may be cast. Some new discoveries may be made which will open up wider lines of research and utility, revealing possibly the existence of unthought-of forces or properties of nature. On the other hand, new and perhaps unexpected combinations of elements already in possession will result in rapid and certain advancement. But a review of the present status shows that in spite of the multitude of glorious achievements, scarcely anything has been added to the anticipations of former times. What now exists was, as a rule, foreseen in its elements; we have added not so much ideas as realization and certainty of thought. In forecasting the probable lines for future advance in applied science, it is well to profit by past experience, examine the elements already at hand, and endeavor to fit them together in new combinations. Narrowing prophetic opinion to the most important achievements tested by their probable influence on science and civilization, the subject of the economical transformation of energy into available power and cold light, seem pre-eminent. So much has been written on these topics that they have become hackneyed themes, but their importance is so great they merit constant consideration. The enormous waste involved in the conversion of the latent energy of coal in power is clearly understood; the great waste in all forms of artificial illumination is equally apparent, though less thoroughly understood.

In short, all present forms of artificial lighting depend upon the self-same principle, in use from prehistoric times,—incandescence of finely divided solids. Nor is the universal medium, carbon, other than our remotest ancestors employed Advancement has occurred only in the methods for rendering carbon incandescent. Until the advent of electric lighting, all illumination was obtained from gas flames, whose principal light-giving element was glowing carbon. The main characteristic of a gaseous flame is its heat-producing power. A very minute portion of the heat is absorbed by any free carbon they may contain, thus affording light. The light from a gas flame may then be regarded as an accidental property, rather than a necessary one. From this view it is clear that a gas flame is an extremely wasteful light-producer. If illuminating gas be considered, five dollars' worth of gas burned yields approximately one cent's worth of light. This is the average record in the chapter of what may be termed accidental illumination. The advent of electric lighting marked an advance in method, not in principle. In the arc and incandescent lamps is witnessed the most scientific method for rendering carbon incandescent; yet the light produced is only a secondary result. The primary action of both types of lamps is the expenditure of energy in overcoming a resistance, with consequent conversion of electrical into heat energy, a portion only being effective in establishing the proper molecular activity for light radiation in a substance whose power of emission is very high. Both the arc and incandescent lamps are in reality heaters and light-producers only to a limited extent. The light energy radiated from the incandescent lamp is variously stated to be from a fraction of 1 per cent. to 5 per cent.; of the arc lamp, from 8 to 15 per cent.; this of the total energy imparted to the lamp. Compared on the basis of total energy in the source, electric lighting is vastly more efficient than gaseous illumination. Briefly stated, light energy is always associated with a very great amount of unavailable heat energy. Since light must in all cases be paid for on the basis of total energy delivered, and further, that sources of energy are not inexhaustible, the problem of light unaccompanied with large heat wastes becomes a very serious one, and appeals to scientific and practical men alike.

The logical method of dealing with a problem is to consider the necessities which originate it, the elements influencing its probable solution, and then the ability of combination to obtain the desired result. The necessity has been outlined, but the solution is still of the future. It is of the greatest importance, then, to clearly grasp the elements entering into the probable solution.

At the outset of such an investigation the question is confronted: What is light? Of all the answers attempted, but two have survived. These are the electromagnetic, or ether-stress, and the mechanical, or ether-vibration theories. The first is based largely on mathematical analysis, the second on a wide range of experimental data. Very briefly stated in the electromagnetic theory of light, the ether figures as a highly elastic and perfectly rigid solid, capable of having stresses impressed upon it, but not of material displacement of any portion. A material body, such as a condenser or Leyden jar, when it is rapidly charged and discharged with electrifications of alternating signs, is supposed to impress upon the adjacent ether alternating stresses of like periods; these stresses are propagated radially with a velocity of 186,000 miles per second, the alternations of the stress occurring transverse to the radius of propagations. In this way a wave, resembling the ordinary sinusoidal alternating-current wave, is established. This conception agrees with experimental data, which shows beyond all reasonable doubt that light and heat waves are such transverse vibrations in the ether.

The mechanical theory of light traces the origin of light waves to the rapid vibrations of molecules. Such molecules resemble a disc in motion rather than a tuning-fork, since no molecule is known which does not emit a greater or less number of waves of different periods. Waiving for the present an examination of how the molecules are set in vibration, such discs may be regarded as in rapid motion in a highly elastic, finely granular solid or jelly-like substance, the ether. As the discs vibrate, they set up alternating displacements of ether particles, which are transmitted with the known velocity of light as transverse waves. The two theories agree in point of velocity of propagation and wave forms, but differ in the nature and origin of light waves. According to the electromagnetic theory, only one form of wave is possible in the ether—the transverse. The mechanical theory necessitates the simultaneous production of both transverse and longitudinal vibrations or waves, the two systems being at right angles in direction of propagation. This is apparent if a tuning-fork be imagined vibrating in a mass of jelly. At present but one form of ether-wave has been positively proven to exist—the transverse. It was on this fact that the electromagnetic theory was based, and the unproven presence of longitudinal vibrations has been the most valid argument against the mechanical theory. Should investigations, now so universally carried on, prove with equal clearness the existence of longitudinal ether vibrations, the mathematical theory of light must needs be seriously modified, while the mechanical theory would be demonstrated beyond reasonable doubt. This matter has a most important bearing on investigations on the production of cold light, since if longitudinal vibrations exist, the ether must be considered granular, capable of at least minute condensations and rarefactions, and not as a perfectly rigid solid.

Experimental evidence has clearly established that light and heat are in transmission transverse ether waves, similar in form and differing only in period. The period limits throughout which heat waves have been detected, lie between 100×10^{12} and 400×10^{12} per second; those waves whose periods lie between 400×10^{12} and 750×10^{12} affect the sensory apparatus of the eye as light. Waves whose frequency exceeds the highest value noted are invisible and only produce effects which lead them to be termed actinic or chemical rays. To produce cold light it will not suffice to merely set up transverse vibrations in the ether, but such vibrations must be strictly controllable within the limits of visible rays.

Having determined the character and limits of the ether waves, the next inquiry will deal with the possible methods of impressing such disturbances on the ether. Broadly speaking, two such methods present themselves; one may be termed the intermediate, the other the direct. The former may be examined with confidence, since up to the present it has been the only available means for the production of light. Given matter and ether, how may the former affect the latter? If we accept the ether as being finely granular and capable of slight displacements, waves in it can have but small amplitude, and can be established only through the agency of molecular and not molar masses. What may be termed the inertia-time-constant of a molar mass, however small, is yet too great to set up true ether waves; in such cases the ether must simply flow *around* the moving mass. As well might sound waves be attempted by moving a door rapidly on its hinges.

The problem narrows down, then, to the ultimate stable divisions of matter, the molecule, which is sufficiently rapid in its movements to exceed the inertia-time-constant of the ether particles, which thus suffer a true *displacement* rather than a movement of *flow* around the disturbing matter. Could the molecule be given a *governable* period of vibration, would not the problem be solved? Take the carbon molecule, for example. Spectrum analysis shows such molecules vibrate as discs rather than simple tuning-forks; that is, though they possess a certain fundamental period, there are present with it a great range of harmonics. Spectrum analysis further shows that the molecules of the different elements do not possess an equal number of harmonics. Many impart to the

ether a very much smaller number of different wave-periods than those of carbon. Extending this further, it might be supposed that some substances exist whose molecules are so little flexible that they possess but a limited range of periods. Sodium is such a substance, but the light it emits is approximately monochromatic. But it must be borne in mind that to produce the usual illumination the substance must vibrate through about all the visible spectrum, just as carbon does, thus producing *white* light. Unfortunately, when energy is imparted to molecules to render them luminous, the greater part of the energy is radiated in waves of large amplitude and long period or heat waves. Light, so far as is known, is only the result of a molecular quivering established by impact or collision, so it would seem impossible on such lines to avoid heat waves. The problem for the future may then be briefly stated, to set up *controllable* molecular vibration without the intermediate collision or impact. This excludes the production of light by chemical means or methods involving fluorescence, or, as it is incorrectly called, phosphorescence.

It must be further emphasized that the light-producing molecules must not be gaseous, but constituents of at least very minute particles, since the total mass of a gas is too small to transform any considerable amount of energy or produce a light of much intensity. In illumination by fluorescence the vibrations are set up by impact of rapidly moving gaseous molecules on those of a solid. This gaseous bombardment only amounts to an attempt to shoot light into existence, and must necessarily be associated with a certain heat waste. On this point too much reference has been made to the glow-worm and firefly as ideal sources of cold light. In at least one system of so-called phosphorescent lighting the efficiency of insect generators has been attained; but in spite of the bolometric observations made on such creatures, we cannot but believe that in the production of their light they do emit or absorb in their bodies a certain amount of heat energy, and were these light sources increased in intensity to the candle-power of an arc lamp, they would be found to fall far short of the economical ideal of light production which we trust the near future holds in store.

To summarize, if light is to be produced through the intermediate agency of molecular vibrations, these must be established by direct means rather than impact and collision. What are such available or direct means for transferring energy from a source to establish the requisite molecular vibrations? Our present knowledge indicates but two methods—the electrical and electromagnetic. Heat is excluded for the reason that it induces primarily only molecular trajectory motion, and the wave-period is "stepped-up" as the result of impact. The electrical method would be along the line of rapidly alternating statical charges, accompanied by very high potentials. Should longitudinal ether vibrations be proven possible, one is tempted to frame a mechanical theory of the possibility of inducing direct molecular vibrations, but our present knowledge of the ether scarcely justifies such procedure. The electromagnetic means might be employed along the line of rapidly pulsating or alternating fields, and here, too, a mechanical theory might be formulated which should attempt to explain diamagnetism and point out how such property might be available for the production of light.

Our inquiry now leads us to a field in which there is much speculation and but little real knowledge, for here we treat of the direct and governable impressment of transverse vibrations on the ether. It has already been shown that it is improbable that the ether may be affected by any mass of matter other than molecular in size, and that the available agencies for accomplishing this seem limited to electrical and magnetic forces. Why may not the mediate agency of matter be avoided and the ether directly affected by these forces? Cold light being thus accomplished, what might we not hope for in influencing the properties of matter and chemical reactions? To recur to the electromagnetic theory of light, it is supposed that a charged body stresses the ether in its vicinity, and let it be granted that this stress consists in a true displacement of ether particles. If such charge be rhythmically alternated, we are led to conclude that a true transverse vibration is impressed on the ether. It would thus appear that the light problem would be solved could these alternations of charge occur with the required frequency of light waves. A Leyden jar, in discharging, furnishes us with the necessary series of alternating charges, but the period of such alternations is dependent upon the time-constant of the jar. In short, the Leyden jar, to produce the required light vibrations, could possess but molecular dimensions. Seemingly an insurmountable barrier is met here, but probably the obstacle is in our ignorance rather than existent in nature. We know scarcely anything of what constitutes the phenomena involved in imparting an electrical charge to a body. To speak of it as a mere ether stress seems but to be giving a mere name to our ignorance. Shall we, then, deal with such matters as if something wholly apart from demonstrated phenomena? To do so would be to violate the development of science. A more rational procedure would be to consider the actions involved in charging and discharging a body as mechanical in nature, thus bringing them within the power of our analysis. Starting with the ether, which is at most slightly compressible, it does seem as if a satisfactory mechanical theory could be framed to account for the phenomena of charged bodies. With this in possession, we may yet find means to alternate molecular charges. The same observations may be applied to electromagnetic actions, for these yield readily to mechanical analysis.

Unless the production of cold light is to be stumbled upon by mere accident, its scientific accomplishment must be preceded by satisfactory theories of the mechanical relations in the phenomena of charged bodies and electromagnetism. Granting that magnetic lines of force are ether vortices, and that an electrical current flowing in a conductor possesses a rotation, a most satisfactory mechanical theory of magnetism can be evolved.* In this connection it has occurred to the writer to investigate the atomic mass of the elements to determine the probability of magnetic property being a function of the mass. The limits of the present article will only permit the merest mention of the results.

Magnetic Mass-Function.	Atomic Mass.	
Iron	56	
Nickel	59	
Cobalt	59	
Manganese	55	
Chromium	52	*

If we adopt the atomic weight of 56 as the mass with which magnetism is most pronounced, the magnetic property of a substance would be determined by its approach to this atomic mass, or, as in the case of oxygen, to some periodic function of it. By the extension of the mechanical relations here suggested, the phenomena of diamagnetism seem to find a rational explanation.

Does the problem of the controllable production of light seem hopeless? In the light of present achievements it does not. The consummation may be a matter of only a few, or perhaps of many, years, but its ultimate accomplishment seems almost a certainty.

A Modern Central Station.

An interesting paper was read before the New York Electrical Society, on Feb. 26, by Mr. John W. Lieb, Jr., on "The Generation and Distribution of Current by an Edison Station," which also included an account of the growth of the New York Edison Illuminating Company's systems from the commencement.

Mr. Lieb emphasized the fact that in the modern central station the problems within the station—problems of generation or manufacture—are in mechanical rather than electrical engineering. The best types of multi-expansion condensing engines rarely transform more than 15 per cent. or 16 per cent. of the heat energy of the coal into dynamic energy, and, in the common forms of non-condensing engines, not more than 6 per cent. of the coal energy is available at the fly-wheel of the engine. Under the conditions found in most electric light stations, these efficiencies cannot be approached. Taking into account the variable loads on engines and boilers, condensation in steam pipes to the power required for the auxiliaries, with the other losses, the total efficiency of the transformation into electric current seldom, if ever, exceeds 8 per cent., and is usually not greater than 3 per cent.

The electrical efficiency of the best types of dynamos of the size used in the larger stations is seldom less than 90 per cent., and, in the larger sizes, is as high as 96 per cent. These efficiencies diminish but little under the partial loads ordinarily carried in a well-designed station having generating units of several sizes to maintain a high ratio of capacity to output. With the generators at the Duane Street station it is possible to obtain a ratio of output to dynamo capacity in operation of 92 per cent. between the hours of 9 a.m. and 6 p.m.; during the 24 hours this ratio is reduced to an average of 85 per cent. as the smallest unit available has a capacity considerably in excess of the requirements during the minimum hours.

It is safe to say that of the energy delivered to the engine shaft, from 75 to 85 per cent. in the smaller stations, and from 85 to 90 per

*See paper by the author on "Magnetic Mechanism," *Electrical Age*, Feb. 9, 1895.

cent. in the larger, is delivered as electrical energy to the switchboard, including losses due to the inefficiency of the dynamos, in the leads to the switchboard, in the contacts, etc. It is evident, therefore, that the losses due to the inefficiency of the electrical apparatus in the station are small as compared with those due to the inefficiency of the apparatus engaged in the conversion of heat energy into dynamic energy, and in the auxiliary apparatus the great problem in the mechanical operation of a station is to reduce these losses to a minimum, approaching as nearly as possible the conditions of maximum economy—the coal consumption, per unit generated, approaching what its value would be if the whole station were operated at the load of maximum efficiency for the 24 hours.

The problems which are more specifically electrical in their nature are those connected with the delivery of the current from the switchboard into the system of mains and feeders which distribute the current to the consumer's premises and its transformation there in the form of energy desired.

The loss of energy in the conduction of current from the switchboard to the point of consumption depends upon the factors, current, pressure, sectional area of conductors, and their length. For each particular case there exists a fairly definite relation, from which, given the cost of producing the current, the average use of current, or the load factor, the distance to the point of consumption, and the cost of the conductor per unit area, the most economical section can be determined. It would, of course, be out of the question to make this calculation for each consumer, or group of consumers, but it must be taken into account when it is a question of supplying current at considerable distances from the station. Erroneous ideas are held as to what the actual losses are in a network of feeders, mains, and services distributing current from an Edison station. It may be interesting to note that the drop of voltage, due to resistance of conductors between the switchboard and the consumer's services, on the Edison system in New York amounted to an average of 7 per cent. during 1895. To this should be added an average drop of 2 per cent. to 2½ per cent. on the consumer's wiring between the service and the lamps. This drop has been reduced considerably, as well as the investment cost for conductors, by the use of two or three "bus" pressures in the modern station, grouping the distant or heavily loaded feeders on the "bus" carrying the high voltage, and the short or lighly loaded feeders on the low "bus." The same result is obtained by the use of a "booster" inserted in series with the feeder, which adds to the "bus" pressure the voltage necessary to overcome the drop.

Notwithstanding the much-talked-of leveling of the station load curve due to the installation of motors, it will be found that as a station increases in capacity the ratio of maximum load at any time to the total connected installation will continue to fall. There is a limit, of course, beyond which this decrease is not likely to go, depending largely on the further uses to which electricity will be applied.

In an industrial district, where the motor load is heavy nearly all day, the lighting load is comparatively light, except during the Winter, when darkness sets in early, and the motor and lighting loads overlap. In a district of this kind, moreover, there is but small demand for light at night. In a residential or shopping district, on the contrary, the motor load is of less importance, and the lighting load becomes great immediately upon the approach of darkness, reaching a maximum in the evening and extending some into the night.

These characteristics are clearly shown by the load curve of the First District, extending from the Battery to Fourth Street, and also by the load curve of the Second District, extending from Fourth Street to Eightieth Street on the East Side. In the First District motors represent nearly 42 per cent. of the total installation, and the output to motors during last year was nearly 45 per cent. of the total output of the district. The ratio of maximum load at any one time to connected installations varied from 21 per cent. in Summer to 38 per cent. in Winter, the load factor—the ratio of average load to maximum load—averaging about 26 per cent. during the entire year. In the Second District the motors represent only 17 per cent. of the total installation, and the current delivered to them during the year represents only 16 per cent. of the total output of the district. Yet the percentage of maximum load to connected installations varies from 16⅓ per cent. in Summer to 38 per cent. in Winter, while the load factor exceeds an average of 30 per cent—more than 4 per cent. higher than the average of the First District.

It is interesting to note that the daily average use of each incandescent lamp installed is almost identical with the daily average use per rated horse-power of motors installed. This fact, if taken alone, would be misleading; it should be remembered that an incandescent lamp is used at its full candle-power, whereas the current consumed by the motors will average less than ¼ or ⅓ their rated capacity.

Although motor service is, on the whole, advantageous, a station, owing to the long average use in proportion to the time of maximum current demand, can, therefore, be sold at a considerably lessened rate than in the case of arc or incandescent lighting, but it is not an ideal service. This is due to the fact that the motor load overlaps the period of maximum demand for lighting, and, therefore, becomes part of the maximum load on the station, for which generating and distributing capacity must be provided. The ideal service for leveling the load curve, which all station managers are striving to do, is one which ceases before the time of maximum lighting, and which would not, therefore, call for additional and special investment. It is hoped that some such application may appear in the many uses which are being found from time to time for the electric current.

Public Electrical Enterprises in Massachusetts.

From a comprehensive paper read March 5 by Mr. Everett W. Burdett before the Electric Potential Club of Boston, on "The Legal Status of Electrical and Gas Enterprises in Massachusetts," we extract the following statistics relating to the public electrical enterprises in the State of Massachusetts:

There are 60 electric lighting companies with an aggregate capitalization of $9,237,400, and a bonded indebtedness of $4,554,531, making a total of $13,791,931.

There are 75 street railway companies, most of which are operated by electricity, with a capitalization of $27,906,685, and a bonded indebtedness of $22,284,500, making a total of $50,191,185.

The telegraph and telephone companies actually operating in Massachusetts, with the exception of the Bell Telephone Company, whose operations are not local and which does not use the public streets in the prosecution of its business, are not organized in that State, though the subsidiary companies which merely hold the locations used by the other companies are domestic corporations. The amount of their capital employed there actually cannot be ascertained readily from official sources. But the following figures, furnished by the attorney of the New England Telephone & Telegraph Company, are interesting in this connection:

The total amount invested in the telephone industry in New England is $16,800,000. The mileage of telephone wire in New England is 94,328 miles, of which 28,522 miles are underground. There are 42,217 exchange subscribers in a population of 4,700,000.

The following comparisons are interesting and instructive in this connection:

In France, with a population of over 38,000,000, there are only 30,000 subscribers. In Great Britain, with about the same population as France, there are 75,200 subscribers. In Germany, with a population of nearly 50,000,000, there are 83,400 subscribers. From which it appears that France, with more than eight times the population of New England, has a smaller number of subscribers; and Germany, with over 10 times the population, has only twice as many subscribers.

Excluding telegraph and telephone companies for the reasons above stated, and taking account only of the lighting and street railway companies, there is a total investment in Massachusetts of the enormous sum of $84,926,096.

Some idea of the extent of the business done and the service given by these companies in the geographically small State of Massachusetts may be gathered from the following figures relating to electric enterprises only:

Number of electric arc lamps	17,293
" " " incandescent lamps	444,991
(Private 431,826, public 13,165,)	
Number of power motors (not for street railway service)	3,481
Horse-power of power motors above	10,925
Amount of street railway trackage	1155 miles.
" " " " operated by electricity	1002 "
" " " " " " horse-power only	61 "
Number of cars operated by electricity	3431
" " electric motors for propelling cars	4704
Horse-power of motors above (estimated)	129,360
Number of horses in use in 1895	1436
" " " " 1887	11,874
Number of passengers carried in 1895	259,794,308
" " " by horse-power only in 1888	134,478,319

(or an increase of about 100 per cent. in seven years.)

Notes on Accumulator Testing—III.*

BY CARL HERING.

It is always preferable to use a batch of accumulators as the source of current for charging, as the readings are then more nearly constant; two cells in series and two in multiple, of the same size as the cell to be tested, will be found very convenient. A steady source of current of considerably higher voltage and a large resistance in series with the cell will also be found very good.

If two or more like cells are to be compared, it will save much trouble and be more accurate if they are tested in series, cutting out each one as it is discharged or charged; the voltages should then be measured at the terminals of each cell. They should never be tested in multiple arc unless their average is what is wanted, but as one of them may then discharge more rapidly than the other, the average is not a correct indication of the behavior of that type of cell. If two cells are to be compared, some factor must be made the same in both, especially if they are of two different types, sizes or weights; among these factors are the rate in hours, the discharge in watts per pound, amperes per pound, or either, per dollar of cost price, the watt-hours per pound, the ampere-hours per pound, or either, per dollar of cost; the choice will depend on which the most important factor is for the particular comparison.

The time interval at which readings are taken depends on the rate in hours, as also on the steadiness of the source of current, and on the reliability of the measuring instruments. If the source is not a steady one, or the instruments sluggish, the more frequent the readings the better, but for good conditions such a time interval as will give about 20 readings will in general give sufficiently accurate results.

It is well to take a voltage reading on open circuit just before starting the test, as this sometimes serves as a guide, the voltage being often a very good indication of the condition of the cell, although not an infallible one. The open-circuit voltage may also be measured occasionally during the test by momentarily opening the circuit. Such a reading, together with the preceding one for the closed circuit (not the subsequent one), enables one to calculate, roughly, the internal resistance, but this is of comparatively little interest, as it is the total loss or rise of voltage and not that due to the resistance alone which is important in accumulator work.

A good, reliable voltmeter should be used, as the voltage is such an important indication of the condition and behavior of an accumulator. It should be connected to the lead terminals of the cell and not to a part of the main circuit leading to them, nor to the coupler, as there is often a rapid fall of voltage in the circuit which should not be credited to the cell. The ampere and voltmeter should not be too close together, as they may affect each other's readings. The ampere-meter should be connected as closely as convenient to one terminal, so that the leakage, if any, passes through the ampere-meter and is included in the reading. Whether there is leakage may be found by connecting the voltmeter between the ground and each terminal in succession; the one at which the deflection is *least* is the one nearest the leaky end; but there is generally no good reason why a cell should not be well insulated for a test. It is well to make the connections with the instruments so that only one change in the circuit, namely, the cutting in or out of the source, is necessary for passing from the charge to the discharge, not only to save time but to be sure that no mistakes occur. Care must in that case be taken to reverse the terminals of the ammeter before closing the circuit.

It is very convenient to use an ordinary cheap clock, which can be set to the beginning of an hour, say to 12 o'clock, when a test is started, as the readings will then be taken at definite marked points on the dial, and the record will give the time intervals directly without calculations, and therefore without introducing that source of error. For very rapid discharges the clock should have a second hand. The time of the day should also be noted, so as to show the time interval between two tests.

The records should contain a column for the time readings (or two columns if no special clock is used) for the amperes and the volts, a blank column for the computed ampere-hours and watt-hours, in case the current varies considerably, and a column for remarks, in which the specific gravity, temperature, gassing and other observations may be noted. If one is not sure that the density and amount of the liquid are correctly proportioned to the capacity, then the specific gravity should also be measured occasionally.

If the current has been kept constant, the calculations consist of nothing more than an averaging of the volt readings, and the calculation of the total ampere-hours, watt-hours and efficiencies. If the current has varied greatly, it may be necessary to calculate the watt-hours for each two successive readings and then average them, depending on the accuracy desired. For short discharges, as also for charging at greatly varying currents, it is often convenient to use ampere-minutes, reducing only the final results to ampere-hours. It is important to remember that an average of the readings will be correct only when the time intervals between the readings are all the same. Should a reading have been missed it must be interpolated before taking the average; intermediate reading must be dropped in averaging. If the final reading is for an odd period, average the regular readings and then add the few odd ampere or watt-hours, obtaining the mean voltage by dividing the total watt-hours by the total ampere-hours, or the final odd reading may be given its correct value in averaging if the method of doing so is well understood. If there are, say, 20 time intervals, there will be 21 readings, including the one at the start. This first reading should not be omitted in taking the averages, and if it is not reliable, as may often be the case, it can be taken from the curve with sufficient accuracy. In general, if a reading is missing or is uncertain, it is better to take it from the curve than to omit it in averaging.

The efficiencies should always be calculated for both the ampere-hours and the watt-hours by dividing those of the discharge by those of the charge, and multiplying by 100. When the current is the chief factor, as in constant-potential systems, the ampere-hour efficiency may be the more important, but when it is a question of the energy, the watt-hour efficiency is the chief one to be considered. There is besides this a third efficiency, which is seldom calculated, but which is nevertheless of some interest and serves also as a single check on both of the others; this is the efficiency in volts and is equal to the mean discharging voltage divided by the mean charging voltage, and multiplied by 100. When compared with the ampere-hour efficiency, it shows at once whether the loss in watt-hours is mostly due to a lack in retaining power of the active material, to leakage and gassing, or whether it is due chiefly to internal resistance and polarization, and therefore this volt efficiency serves as a rough indication of the cause of the lost energy. The volt efficiency multiplied by the ampere-hour efficiency and divided by 100 must equal the watt-hour efficiency, thus serving as a check on the calculation of the two latter.

As the source of current in an accumulator plant must be able to generate the highest voltage at the end of the charge, and as the lowest voltage at the end of the discharge must still be high enough for the incandescent lights, motors, or whatever the power is to be used for, it follows that these two voltages are very important and should be noted; the number of regulating cells, the capacity of the regulator and the E. M. F. of the generator all depend on them. If the cell is forced too much so as to get the greatest storing capacity the difference between these two voltages may become quite great, necessitating a large amount of regulating; it may, therefore, be better, in some cases, to reduce the capacity by shortening the charges and discharges and thereby diminish the amount of regulation which is required.

As the curves drawn through the plotted results show so much more at a glance than columns of numbers, it is much better to draw these, at least for a few of the more important tests. The most useful among them are the curves showing the rise and fall of the voltage during charge and discharge. In these the horizontal distances are usually made to represent the time and the vertical ones the voltage. The latter should begin at the lowest voltage, say at 1.7 instead of at zero, as this will magnify the curve in that direction. To begin at zero and use a short vertical scale will give an attractive-looking horizontal curve, which may be well suited for advertising catalogues, but is of little use to the engineer and of no use to the constructor. The vertical-scale units should be large and the horizontal ones small, so as to get a decidedly inclined line.

Portable cells, or in general those in which the weight is important, even if they are of different types, sizes or voltages (as for instance the copper-zinc, the lead-lead, and the lead-zinc cells), may be compared with each other if the vertical scale is made watts per pound, instead of volts. The curves thus obtained are quite similar in outline to the volt curves, only that the vertical distances for each will be different, even though the voltages are the same. Such a set of curves may be made to include the capacities also, and thereby become much wider in their scope, as it is very important to be able to connect the capacities with the respective powers in watts. To do this the curves are continued to the left across the zero line, as horizontal lines, the *lengths* of which are made equal to

* Continued from THE ELECTRICAL WORLD, Feb. 22, 1896, p. 203.

the respective capacities in watt-hours per pound (not simply in watt-hours). If such a set of curves and horizontal lengths are drawn for a single cell, the weight may be omitted in both, as it is constant ; the vertical distances will then be watts, and the horizontal distances to the left watt-hours.

Other interesting and instructive curves are those showing the relation between watt-hours and time, ampere-hours and time, watt-hours and watts, and ampere-hours and amperes, all of which have already been referred to above.

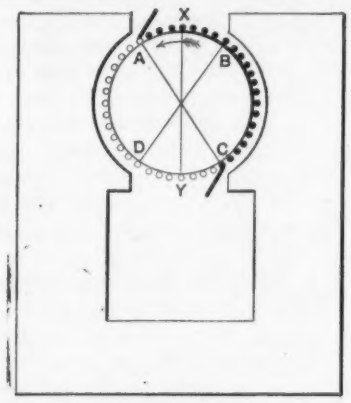
(*To be continued.*)

Fly-Wheel Accidents.

To the Editor of The Electrical World:

Sir:—The criticism offered by "Engineer" in your issue of Feb. 22 on the subject of "Fly-Wheel Accidents" shows that he did not understand my statements published in the issue of Feb. 8. He is particularly in error in his statements concerning the armature reaction of dynamos running as motors.

My statement was to the effect that armature reaction in a dynamo running as a motor and *having a dynamo lead* would tend to *strengthen* the fields. The reason for this may be seen by studying the accompanying diagram. The total effect of armature reaction may be considered as the resultant of two components: first, a cross-



magnetizing effect, or one which tends to send lines of force in a direction at right angles to those of the field ; and second, a magnetizing or demagnetizing effect, as the case may be. Suppose the diagram to represent a loaded dynamo. The brushes are given a forward lead to *A* and *C* in order that commutation may take place in the fringe of the field. That part of the armature winding included between points *A D* and *B C* can evidently have no effect on the field except that of distortion; but the parts between points *A B* and *C D* are working in direct opposition to the field. Now, *without changing the lead of the brushes*, consider this dynamo to be running as a motor. The current is reversed through the armature, and consequently the cross-magnetization due to parts *A D* and *B C* is reversed, but its only effect is to saturate the pole tips opposite to those saturated when running as a dynamo. But the portions *A B* and *C D* are tending to strengthen the field.

It is also evident that armature reaction, either magnetizing or demagnetizing, grows less as the brushes approach the neutral diameter *X Y*. This reasoning leads us to several conclusions, among them the following :

The greater the forward lead on a compound dynamo, the less it will over-compound.

A shunt dynamo run with a backward lead may be made to over-compound without the use of series coils. The reason for not over-compounding dynamos in this way is the consideration of sparking.

A shunt motor run with a backward lead will speed up as the load goes on, and run with a forward lead will slow down as the load goes on.

A motor may be run without any field, except that induced by the armature, if the brushes are given a sufficient lead. It will act like a series motor having few turns on the field. The direction of rotation will be such that the brushes will have a forward lead. If "Engineer" will investigate, he will find all these statements to be true. So much for generalities.

Now let us apply this reasoning to "Engineer's" particular case. "Engineer's" method of reasoning seems to be as follows: "This theory carried out means that bucking is an impossibility. But bucking is possible; therefore, there is something wrong with the theory." This result does not necessarily follow. Bucking is quite possible, and in some stations is quite probable, but not on account of armature reaction, as "Engineer" suggests. Applying the above theory, we find that if "Engineer" runs his dynamo with a forward lead, as he doubtless does, armature reaction strengthens the field in case a dynamo runs as a motor. With equalizers of no resistance, bucking would be an impossibility. But, unfortunately, equalizers have resistance. Two hundred feet of leads—allowing 300 amperes to a No. 0000 wire—will have a resistance approximately equal to that of a well-designed series coil. That is to say, if the leads have to run a distance of 200 feet to the switchboard, one third of the current running a bucking dynamo will pass backward through its series coil, considering no external load. In most cases, this would be enough to overcome the magnetizing effect of the armature. In some stations the leads are even longer than this, causing still more current to flow backward through the series coils. It is probable that this is the case with the dynamos which "Engineer" cites. It may be further said that it is the function of an equalizer to prevent bucking, and where it is not prevented the equalizer cannot be properly installed. When the leads to the switchboard are necessarily very long there are two expedients that may be employed: The cross-section of the equalizer lead may be increased and reduced in resistance; or, resistance may be introduced into the positive lead. Each has the same effect—to prevent current from being shunted backward through the series coil of a bucking machine.

Paul M. Lincoln.

Niagara Falls, N. Y.

Standard Electrical Rules.

To the Editor of The Electrical World:

Sir:—On behalf of the Committee of Standard Rules for electrical construction and operation of the National Electric Light Association, I wish to state that, after mature deliberation, it has been decided to extend an invitation to the Underwriters' National Electric Association to send a delegate to the joint conference to be held on March 18 and 19. This association has been added to the list published in the recent issue of your journal, of 11 organizations already co-operating. Our committee was led to this action, which has been under consideration for some time past, by reason of the fact that they felt that, while the insurance interests of the country would be ably taken care of by the representative of the National Board of Fire Underwriters, and although they realized that the Underwriters' National Electric Association acts merely in an advisory capacity, being composed of the electrical inspectors from all parts of the United States, and having no authority in itself as an association, yet so closely were they identified with the preparation, endorsement and enforcement of rules for electrical construction and operation, and so alive to the practical questions which would come before the joint conference, that the committee felt it advisable to extend an invitation to their organization to send an official delegate on the same par with the 11 other interests already invited.

Following is a list which has been prepared of complimentary delegates to be invited to the joint conference in an advisory capacity; but solely as individuals and not as representing any association or manufacturing interests. These gentlemen, by reason of their experience, the nature of their occupation, their identification in the past with work such as the proposed joint conference will consider, together with their prominence in electrical engineering matters, have been considered by the committee as likely to lend valuable advice and additional strength to the joint conference: Wm. MacDevitt, inspector Board of Fire Underwriters, Philadelphia, Pa.; A. E. Kennelly, consulting engineer and expert, New York; W. J. Jenks, electrical engineer and expert, New York; A. H. Henderson, Chief Inspector Fire Department, New York; Morris W. Mead, Superintendent Bureau of Electricity, Pittsburg; Prof. Wm. A. Anthony, consulting engineer; E. H. Johnson, New York; S. E. Barton, New York; E. V. French, inspector Factory Mutual Fire Insurance Company, Boston.

The committee has in preparation a transcript of the various codes most extensively in use, and this, in a convenient and compact form, will be in the hands of each delegate prior to the meeting, at which meeting a large amount of additional matter bearing upon American and European practice will be available, and it is the intention that in the consideration of the various rules presented at the joint conference, the decision as to what shall be adopted for the national code will be governed solely by the law of the "survival of the fittest."

Wm. J. Hammer,

New York. *Chairman Com. N. E. L. A.*

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

LIGHTS AND LIGHTING.

The Electric Arc. HERTHA AYRTON. Lond. *Elec.*, Feb. 21; the conclusion of her long serial (see *Digest*, Jan. 4).—The ratio of the power expended in the silent arc and the power developed by the generator is discussed at some length; in the former installment of this serial she showed that this ratio would have the greatest value under certain conditions, but one is not free to choose the variables in this way; in the present portion she considers each of the three quantities, the E. M. F. of the generator, the current and the length of the arc, as being fixed in turn and then considers under what conditions this ratio, that is, the voltage at the terminals of the lamp divided by the voltage of the generator, will be greatest in each case. With a fixed voltage this ratio is greatest when the current is the largest that can be maintained through a silent arc of the greatest length; the equations for each case are given. When the current is fixed the ratio is greatest whatever length the arc may have, when the smallest E. M. F. is used that will send this current through that length of arc, and when the line representing the resistance is a tangent to the curve connecting the voltage at the terminals and the current for that length of arc; when the current is fixed the conditions are that the arc shall be the shortest that will emit the desired light, that the E. M. F. of the generator shall be the smallest that will send the current through this arc, and that the external resistance shall be such that the line representing it will be a tangent to the curve for this arc at the point where the current is the fixed amount, consequently the resistance must be the smallest with which the fixed current will flow through the shortest length of arc. When the external resistance is the fixed quantity, the ratio will be greatest when the arc is the shortest that will give the desired amount of light, when the current is the smallest that will flow through this length of arc with the given resistance in circuit, and when the voltage of the generator is the smallest that will maintain that current under those conditions. A few examples are worked out to illustrate the application of the foregoing methods of obtaining the greatest value of that ratio; the direct application of the formulas give results which cannot actually be used, but will serve as guides in the choice of the actual value; in the case of two lamps in series on a 110-volt circuit, the length of the arc will be 2.5 mm, the current 14 amperes, the resistance 0.6 in series with each lamp and the value of the ratio will then be 0.85, which means that 85 per cent. of the power developed by the dynamo will then be expended in the lamp; when the lamps are all in series, she assumes a current of 10 amperes and 3 mm for the best length ; the direct values found from the equation give results which cannot be used, as the arcs would be too unsteady, but they will serve as guides ; for the best figure she finds that the voltage at the terminals of the lamp and resistance in series, is 60, the resistance will then be 1.06 and the ratio 0.82 (the true series system used in this country, in which no resistance is placed in series with the lamp, is not discussed ; presumably the case which she refers to is that of a number of lamps in series run from constant potential mains). The smallest resistance that can be placed outside of a silent arc with given carbons is then discussed ; she finds that when the arc is silent and its length is fixed, the smallest external resistance that can be used with any current varies inversely as the square of that current ; from this it follows that with a fixed length of arc, the larger the silent current the smaller is the smallest external resistance, and, therefore, the smallest resistance is the smallest with which the largest silent current will flow ; formulas are given, and it is shown that in order to maintain a silent arc at all, the total resistance external to the arc cannot have less than a certain minimum value which depends solely on the carbons used. The equation of the hissing curve is discussed briefly; it is shown that there is a maximum current with which a silent arc can be maintained and any current greater than this will cause the arc to hiss however long it may be; it appears that whether the carbons be cored or uncored the fall of voltage that takes place when the arc changes from a silent to a hissing one, is constant for any given carbons, that is, it is independent of the length of the arc and the current that causes hissing; the rise of voltage when the arc suddenly becomes silent is not quite as great as the previous drop was, the difference being of half a volt to a volt. The distribution of potential in the arc or the true shape and size of the arc, have not been touched upon, but she hopes to publish the results of many experiments soon.

Arc Light. ARONS. *Zeit. f. Beleucht.*, Feb. 20; an abstract of some length from the *Wied. Ann.*, Vol. 57, p. 185.—He describes experiments made to determine whether there is a counter E. M. F. in the arc. Stenger some time ago connected a galvanometer in series with the arc, and arranged it that the needle could deflect only in the opposite direction to that produced by the original current; on short-circuiting the dynamo no deflection was produced in the galvanometer by the action of the supposed counter E. M. F.; when some accumulators were put in circuit, which were charged by the original current, they produced a strong current under the same circumstances; he considered this a proof that there was no counter E. M. F. in the arc. Arons considers that this is not conclusive, as he did not find the limit of the E. M. F. of the battery which the voltage must have to produce the currents between the carbons; the present researches were made to find this limit; that there was such a limit, he concluded from the fact that an alternating arc between the carbons was possible. With a resistance of 0.4 ohm, 18 volts of the accumulator battery was necessary to produce a deflection of the galvanometer, that is, to pass a current through the gaseous space between the carbons; to produce an arc in the opposite direction 30 volts were required, but the arc continued only for a few seconds; for a continuous arc 70 volts were required; he concludes that there is a counter E. M. F. which vanishes very rapidly; from measurements of the current and voltage of the arc after a short circuit, which showed a voltage of 10 to 14 less than that of the accumulator, he determines the counter E. M. F. of the arc (the value of which, however, is not given in the abstract). With metallic electrodes he could not obtain any signs of a momentary current after short-circuiting, even though the voltage of the battery was 76; from this he concludes that an alternating arc between metallic electrodes was not possible, assuming that the voltage did not reach that required for sparking across; with voltages of 240 to 360 and a frequency of 200 and electrodes of various metals only a short, sharp spark could be produced; for distances even much smaller than 0.1 mm no sign of a current was found. Between the carbon and metallic electrodes an alternating arc can be maintained, the light from which shows the lines of that metal in the spectroscope. He concludes that as the heat conductivity of the carbon is less than that of the metals, its temperature on striking the arc is higher, and that between glowing electrodes a current will be produced even with comparatively low voltage; it is possible that these weak currents allow the arc to continue; metals produce only their own vapors, while carbon gives off gases which will probably last longer than the vapors of the metals; the products of the carbon are gaseous, while the metallic electrodes are soon covered with oxidizing, non-conducting layers which probably act to prevent the arc from re-lighting.

TRACTION.

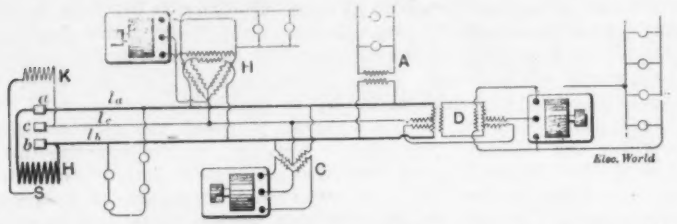
Electric Traction and Telephonic Distribution. KOLBEN. Lond. *Elec.*, Feb. 21.—A communication replying to the article by PRELLER, which was abstracted in the *Digest*, Feb. 1. It is claimed that most of the conclusions made in that article are incorrect and misleading; the method of suspending the contact wire on railways has nothing whatever to do with the telephonic disturbances; it is perfectly immaterial whether the wire clamps are soldered or whether they are mechanical clips; or whether the wire is smooth or rough, old or new; none of these conditions affect the well-known continuous sounds produced in telephones; the sounds would not be continuous if produced by interruptions of the current, such as caused by these conditions. The statement that trolley contacts cause serious trouble in telephone circuits while sliding contacts do not, has no foundation in fact, and is in contradiction to well-known facts; the shape of the contact does not alter the conditions; the disturbances are independent of the design of the motor, and the noise produced by the gearing has nothing in common with the telephonic disturbances. He does not discuss the real cause of the disturbances, but considers that it has been carefully investigated, and gives a number of references; the real cause of the disturbances at Marseilles was the insufficient insulation of the old telephone lines, while at Zurich it was due to "the extreme softness of the soil"; the line at Basle is less than 2 miles long, and for the greater part the rails are embedded in wood pavements, which act as good insulators against the earth currents. This is followed by a short article by Dr. Preller; he considers that Kolben has not controverted the facts, and as to the conclusion he considers that there may be a difference of opinion, but that those which he arrived at are fully endorsed by distinguished electricians who are not manufacturers; he adds that the tests which he spoke of were not measurements made on the line; he believes that noisy gearing gives rise to uneven currents in the line, and hence aggravate telephonic disturbances.

New Heilmann Locomotive. Lond. *Elec.*, Feb. 21.—A note saying that the two new and more powerful Heilmann locomotives for hauling heavy

trains at high speeds, which are now in the course of construction in France, will shortly be in operation; they are intended to haul trains of 290 tons at 62 miles an hour; the horse-power is 1900; the apparatus (which, as will be remembered, consists of a whole generating station, transmitting the current to the motors) is mounted on two trucks of four wheels each; the motors are gearless, driving the axles through elastic couplings; there is a single Willans engine driving two generators.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Alternating-Current Distribution System. Elek. Anz., Feb. 16.—A new system, patented to the Schuckert Company, the object of which is to make the separate branches of a multiphase system independent of each other; in the usual multiphase system unequal loads on the different branches require regulation of the whole system, while in the present system this is avoided; it is termed the "rigid" (starres) system. Two ordinary single-phase generators are coupled together rigidly, so that there will be a certain phase difference between the currents; one of these is intended for light and power purposes, and is called the principal machine, while the other is only for power purposes; the connections are shown in the left-hand part of the adjoining illustration; the main



machine *H* is connected to the main wires as shown; the power machine *K* is connected with one end to the middle of the armature winding of the principal machine, the other being connected to the third lead; motors requiring multiphase currents either continuously or only at the start, are connected to all three of the mains; in the present system the middle wire is intended only for starting such motors, and it may, therefore, be made quite small. Several ways of taking off the current are shown; in the methods marked *C* and *D* an advantage is gained in having two instead of three transformers; any existing single-phase installations can be changed into this system by the addition of the power machine and the third wire.

WIRES, WIRING AND CONDUITS.

House Wiring. Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, Feb. 21. A reprint of the resumed discussion of the papers of Messrs. Bathurst and Mavor (*Digest*, Dec. 21).—Mr. Andrews stated that although the advantages of concentric wiring for street mains would be great, yet the greatest is in the reduction in the cost of interior wiring which would be quite 20 to 30 per cent. less than with casings or conduits; the wide introduction of this system depends on the universal disposition of earthing the distributing network; it should be earthed not at one point but almost continuously; the outside wire should not be bare, but should be protected against electrolysis; the earthed plates alone should be exposed; the benefits of such a self-testing system would, he thinks, entirely outweigh the cost of making the conversion; the outer conductor should be absolutely continuous from the dynamo to the lamp of large section, entirely enveloping the central conductor, switches and fuses; it should be so close to the inner one that it would be impossible to establish an arc without blowing the fuse. If this system were to become general the test to earth would vanish, and the high degree of insulation now required would be looked upon as absurd; the insulating material need only insulate so as not to permit a greater leakage than might be negligible from a commercial aspect; it might be as low as 10,000 ohms per mile, which is 60,000 times lower than that at present in house wiring. Mr. Addenbrook stated that as a rough average the cost of central stations with mains, etc., amounted to about $500 a kw, which represents about 20 lamps of 8 and 16 cp together, or twice that, as a central station generally provides for about double the number of lamps installed; there would thus be 40 lamps wired for each kw; these lamps are averaged at $5 apiece, which shows that while one is spending $500 on the central stations, $200 was spent in the wiring of houses showing the importance of this wiring question, as this item is greater than any single one in the central station except distribution, it being much greater than that of the dynamos, engines, etc. He favors earthing the middle wire; the great cost of wiring houses is at present an obstacle to the introduction of electric light in houses. Mr. Russell thought no practical person doubted the excellent qualities of the two systems of wiring, but he did not see how either of them would assist in reducing the cost of fitting. Prof. Ayrton spoke of the wiring itself; he thinks there has been a confusion between totally distinct considerations, namely, the question of the gauge which was safe, which did not heat by the normal current, and the economic gauge; to illustrate what he meant he made some calculations for a 1 per cent. and a 2 per cent. drop in a building, the light being all at the top of the house; for the 2 per cent. drop the cost of the wire would be 12s., and for the 1 per cent., 17s. The question was whether the latter was worth the extra 5s.; he finds that in two years, and with a 2 per cent. drop, one would have more than paid to the supply company the difference in the cost of the wire, and after this time the owner would be the gainer if he had used the thicker wire; he concludes that a 2 per cent. drop was "an enormous extravagance, an extremely bad investment for anybody who could scrape together enough money to have the thicker wire." He discusses what would be the best drop, assuming that the installation and the current are both to be paid for, and finds that the most economical was to use copper as thick as could be put in so as not to materially increase the cost of labor. He thinks it advantageous to dispense as much as possible with fuses; the old rule to insert a fuse where the gauge of wire was changed, is absolutely unnecessary, provided the fuse protected the smaller wire; he thinks it advisable to use the same fuses everywhere, or at least to make them absolutely uninterchangeable. He advocates highly insulated wire, although the main leakage was at fuses, switches, etc., and this latter can be cleaned, but the wire cannot; he thinks many of the fuses and switches are very badly designed; it is important to have the tape outside of the insulated wire stripped at the end so that it can never come in contact with a live conductor; the screws passing through the porcelain should not be so long as to touch something at the back; if these two points are looked after, high insulation can be attained. If both wires are in an iron tube which is much larger, he finds there is no self-induction effect which would cause a slight extra drop. Prof. S. P. Thompson thought that an important point in Bathurst's paper was that when there were two conductors in a pipe, one of them broke down, a new condition of things was set up, the wire which had made contact with the pipe had now virtually an increased carrying capacity, and the other one would therefore be liable to overheating; there would also be a greater strain on the insulation of the other wire; he therefore considers it of great importance in a conduit system to have some kind of mechanical insulation inside of the piping; he objects to fuses where they are not accessible, as in ceiling roses. Mr. Mavor, in replying, stated among other things that comparing the cost of concentric wiring with that of first-class double wiring, the former was invariably the cheaper; he thought the current-carrying capacity of the wire had very little to do with the fuse; the danger of heating was its concentration at any one point; he thought the fuse should not be proportionate to the size of the wire, but to the current which it had to carry, and it should have as small a margin above that as possible; he thinks the rules should limit the amount of current allowed in any one conductor, and that it should be 50 to 60 amperes; it is important to keep the main fuses as small as possible; the feeding points are the proper places, which should be earthed in such a way that the connection could be removed for testing the feeders up to this point should be insulated.

ELECTRO-PHYSICS AND MAGNETISM.

Production of Electric Phenomena by Means of Roentgen Rays. Righi. Lond. *Elec.*, Feb. 21; translated from the Italian.—He describes briefly the apparatus and the experiments which he made to investigate the effect of these rays on charged conductors. He finds that if a conductor is charged negatively and these rays are made to fall on it, the charge rapidly disappears; if the conductor is not charged, it will be electrified positively by the action of these rays, the final potential being different according to the nature of the conductor, it being greater for carbon than for copper and greater for copper than for zinc; with zinc the charge is negative when the distance to the source of the rays is small enough; if a photo-electric couple, such as he described some years ago, is acted on by these rays a deflection of the galvanometer is obtained similar to that produced by ultra-violet radiations; he therefore concludes that "the X-rays have, in common with the ultra-violet rays, the power of determining the dispersion of the negative charge, and of giving rise to a positive charge in non-electrified bodies"; the electric action diminishes as the bodies are removed from the source; placing thick slabs of wood or sheets of other materials in the path of the rays diminishes the effect but does not completely eclipse it; he found that plate glass alone a centimetre thick is more absorbent than pine wood six centimetres thick. Ultra-violet radiations do not produce a sensible action on positively electrified bodies, for in cases where they seem to do it, it can be shown that the effect is due to the absorption of the negative charge of the surrounding bodies; he concludes that "the X-rays, unlike the ultra-violet rays, cause dispersion, also from positively electrified bodies." "Naturally, while in the case of the initial positive charge, the dispersion ceases when there remains in the conductor a charge equal to that which, when it has returned to its natural state the rays have caused it to acquire, in the case of the initial negative charge the dispersion continues until the body is discharged; and then the process is resumed until it has produced the same final result that it had when the initial charge was zero or positive. This result can be explained by saying that the conductor communicating with the electrometer seems to behave like an exploring electrode immersed in a conducting medium, and which assumes the potential proper to the places it occupies, whatever be its initial potential. Under equal conditions I have not recognized, at least on first examination, any noteworthy difference in the rate of dispersion, according to the sign of the charge, in the bodies on which the vibrations fall." The new properties, which he points out, are valuable as furnishing a means of measuring the X-rays. A lecture experiment showing the dispersion is briefly described.

Roentgen Rays. CAVE. Lond. *Elec.*, Feb. 21.—He describes briefly some experiments to find whether the rays increase the sparking distances in a spark gap; on adjusting a gap connected with an induction coil, he found that the number of sparks was five per minute when the Crookes tube was not in action and 25.8 when it was in action; a piece of zinc 1 mm thick placed in the path stopped this effect completely; ebonite 1 mm thick made little difference; thin sheets of platinum and iron partially stopped the effect; the tube which he used did not give good photographic effects; another tube showing the green phosphorescence had no effect on the spark when excited by an induction coil, but when a Tesla coil was used the effect was very marked. (It is not stated whether there was any connection between the source of the current for the tube and that for the spark, but presumably they were entirely independent.)

In the same issue Mr. PHILLIPS describes an experiment to find whether the rays will pass through a coal gas flame; a small steady lighted gas jet was placed about five inches from the tube and about two inches from the photographic plate; after 20 minutes' exposure the negative showed a clear image of the burner, but no indication of the flame whatever; this was considered all the more curious because carbon is so opaque to the rays, a large quantity of it being present in the flame. He further found that camphor was strikingly transparent, considerably more so than amber, which showed a marked transparency as compared with glass, topaz, mica and quartz, which latter is very opaque. It seems difficult to classify substances with regard to electrical conductivity, according to their behavior toward these new rays. In order to get sharp images he found it an advantage to use leather to protect the sensitive plate as organic tissues are as a rule fairly transparent.

In a brief paragraph signed Blythswood he states that at the suggestion of Lord Kelvin he placed a sensitive plate in a tight zinc box with an aluminum window in the lid; "objects such as small brass wheels were placed either inside the box or outside on the aluminum window. The box was then earthed carefully, and placed between the poles of my large induction machine. The poles were two feet apart to prevent further sparking, as in all my experiments I have used the silent brush discharge. Good photographs were got in about half an hour. The object of placing the photographic plate in a metal box, earthed, was to prevent the possibility of discharge on to the plate."

Lond. *Elec. Rev.*, Feb. 21.—In the brief report of the meeting of the International Society in Paris, it is said, among other things which have already been reported on, that Mr. Perrin thinks he has found in a Crookes tube two fluids of an opposite nature and he is therefore inclined to an electrolytic hypothesis with regard to the existence of these rays. He also showed several impressions of a jugular vein of a frog, injected with mercury.

The same journal contains an illustrated article by Mr. Muras giving a number of illustrations made with ordinary apparatus. In all of his experiments he passed the current through the Crookes tube in the reverse way, the small disc being made the cathode; the piece of platinum foil in the middle of the bulb then appeared quite black on the cathode side, while when the current passed the other way it became red hot. He compared the effects on isochromatic and ordinary gelatino-bromide plates and found that they gave identical results. He found that in this Crookes tube the rays appeared to proceed from the central platinum and not from the electrodes or the glass.

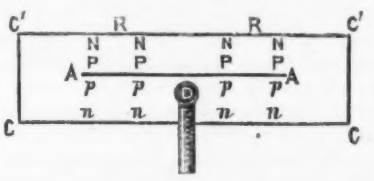
A translation of the short paper of Prof. Salvioni is contained in the same journal; it has been referred to before in these columns, but this is the first reprint of the original paper. He wished to examine if Roentgen's rays could be considered as a form of light in the sense that this agent consists of vibrations of the ether; he doubted whether the power of transparency is due to radiant matter, that is, a matter to which bodies are permeable, so much the more as they are less compact; bodies will be traversed by subtle particles of this matter more or less easily, just as a net with more or less close meshes will be traversed by a discharge of small shot. Among some photographs which he took there was one showing the two lungs of a frog, while in another the heart and in another the viscera were seen. He made experiments on the retina of a living rabbit, which showed that the retina is somewhat fluorescent to the light emanating from the Crookes tube, but there was no fluorescence with Roentgen rays; the various media in the eye intercept the Roentgen rays almost like common glass, that is, they are only slightly transparent. He then describes, but only very briefly, his method of indirectly seeing through bodies opaque to light; the apparatus appears to consist of a tube of cardboard about 8 cm long, one end of which is closed and covered with a layer of fish glue and calcium sulphide, a substance which he found fluoresces with Roentgen rays; the other end to which the eye is applied contains a lens enabling one to see the fluorescent cardboard inside of the dark tube; with this apparatus, which he calls a cryptoscope, it is possible to see even in a lighted space the form and position of metallic bodies enclosed in a box or in the flesh; he thinks it will be found convenient in surgery.

The Lond. *Lond. Eng.*, Feb. 21, states that Lord Blythswood made the important discovery that these rays are liable to something equivalent to color absorption, for on placing strips of colored gelatine in front of the photographic plate the blue was least sensitive, red next and yellow most. Dewar showed that the resistance to the passage of these rays increases with an increase of atomic weight; mere complexity of structure of materials made no difference, but substitution products showed increasing opacity in the order of the atomic weights of the combined chlorine, bromine and iodine. It is reported that Carmichael has found a way of reflecting the new radiations from steel mirrors.

The Lond. *Elec.*, Feb. 21, states that Henry, in *Comptes Rendus*, Feb. 10, states that if some of his phosphorescent sulphide of zinc is smeared to a depth of about 0.5 mm or 1 mm on the back of the gelatino-bromide plate, there will be a notable increase in the photographic action; he also found that a layer of the same substance on the face of a coin or smaller object renders it decidedly more transparent to Roentgen rays.

The Lond. *Elec. Rev.*, Feb. 21, discusses and quotes at some length Lord Kelvin's presidential address of 1893, and calls special attention to the experiments of Varley.

Generation of Longitudinal Waves in Ether. LORD KELVIN. Lond. *Elec. Rev.*, Feb. 21; a reprint of a recent Royal Society paper.—He refers to a short note published by him in a recent number of *Nature* and then shows "an arrangement by which a large space of air is traversed by pressural disturbance, or by waves essentially longitudinal or by condensational-rarefactional vibrations; with but a very small proportion, practically evanescent, of laminar waves." He concludes that if the theory of longitudinal waves suggested by Roentgen as an explanation of his discovery be true (adding that Roentgen has given strong reasons for considering them such) it would seem probable that a sensitive photographic plate in the space between *A A* in the adjoining figure and *R R* should be acted on as plates are by Roentgen rays; in this figure *A A* is a



plain circular plate insulated within a metal case surrounding it as shown, while *D* is a discharger which can be introduced so as to make contact with *A*; either a Wimshurst machine or an induction coil is kept charging the plate with great rapidity so as to cause a rapid succession of sparks between the plate and the discharger. The arrangement might be varied by making the roof of sheet aluminum and placing the sensitive plate or phosphorescent substance outside. If this arrangement gives satisfactory results when no sparks pass between the plate and the roof, or, if it shows a visible glow on phosphorescent material placed anywhere in the space between the disc and the roof, it would prove the truth of Roentgen's hypothesis, that is, that the rays were longitudinal; but a failure to obtain these results would not disprove the hypothesis.

Passage of Electricity Through Gases. LEHMANN. *Zeit. f. Electrochem.*, Feb. 20; the conclusion of his long article (*Digest*, Feb. 29).—The present portion includes two colored plates showing various forms of discharges; one of the illustrations shows each of the four typical forms at various pressures from 70 mm to 1.05 mm. He discusses the following subjects: current lines, cathode rays, striations, the electric wind, the influence of the material of the electrode, double layers, self-induction, luminous discharges, the magnetic wind, discharges in mixed gases and the dissociation theory.

Condenser Analogy. Lond. *Elec. Rev.*, Feb. 21.—A short article giving an analogy of the action of condensers in cable working, using the ordinary hydro-mechanical analogy; electricity is considered analogous to an incompressible frictionless fluid without weight, resistance is compared with friction, capacity to the amount of yielding under a unit pressure due to the specific inductive capacity, which itself is compared with elasticity, while current and E. M. F. are compared with the flow and pressure, as usual. Assume a tube of elastic material, the elasticity being of such a nature that the bore will expand or contract, but the material itself will occupy the same volume; the tube is supposed to be full of liquid and is immersed in another liquid such that any addition to the inside is accompanied by an equal diminution on the outside; "every tube must have a bore and this enclosing a material more or less pervious to the fluid, will constitute an insulated conductor, the actual capacity will therefore depend merely on the surface and the material of the tube wall"; resistance is represented by the material being more or less porous and will be directly proportional to the length of the conductor and inversely to the cross-section; when a pump is placed at one end of the tube, the other being connected to earth, that is, to the outside fluid, the immediate effect will be to expand the tube at the sending end as well as to force the current along the conductor; there must be retardation on the arrival of any appreciable current at the receiving end and also a difference between the forms of the current at the receiving and at the sending ends, causing a distortion of the signals; if a condenser is applied between the pump and the tube, and in this case consisting of an elastic diaphragm between the inlet and outlet connections, there will be a gradual diminishing pressure, so that the outflow at the distant end will be almost the same as though the condenser were absent, but will increase more slowly and fall more slowly. It would also be possible to reduce the distortion by introducing inertia, which would act like a negative capacity; adding inertia may, under certain conditions

introduce oscillating charges. In all of these applications it must be noted that the energy is stored up in the walls of the tube; a diagram is appended giving a small portion of the arrival curve, from which it is seen that if signaling is effected by using only a small portion of the total current, the increase of the E. M. F. will cause very little increase in speed; suppose, for instance, as in the Atlantic cable, that with a certain E. M. F. only about 0.0002 part of the total possible current is used, then doubling the E. M. F. would increase the speed by only 7 per cent.; reducing the resistance of the battery is of great importance, and therefore dry batteries or accumulators should be used for working cables at their highest possible speed.

Dielectric Resistance. Drude. Lond. *Elec.*, Feb. 21; abstracted briefly from *Wied. Ann.*, No. 2.—He works out the analogy of the magnetic resistance and arrives at propositions like the following: "The number of lines of force contained in an infinitely thin tube of force is equal to the difference of potential between its terminal points divided by its dielectric resistance. Or, the capacity of a conductor equals the reciprocal of the total resistance of all its tubes of force ranged in parallel and divided by 4π."

Maxwell's Law. Cole. Lond. *Elec.*, Feb. 21; abstracted briefly from the *Wied. Ann.*, No. 2.—He gives a contribution toward the justification of Maxwell's law regarding refractive indices; for electrical waves 3 to 6 m long, water has a refractive index of 8.95 and alcohol of 5.20; when the waves are shortened to 5 cm the former becomes 8.8 and the latter falls to 3.2; the limiting value for infinitely long waves is the one which suits Maxwell's equation.

Electric and Thermal Conductivity of Alloys. Van Aubel and Paillot. *Jour. de Phys.*, 4, page 522; abstracted briefly in the *Proc. Phys. Soc.*, February.—Wiedemann and Franz found that the electric and thermal conductivities of pure metals are sensibly proportional; the object of the present research is to determine whether the same case holds in case of alloys. Various alloys are tested; thermal conductivities are measured by Despretz's method, and electrical conductivities by Kelvin's double bridge method; the authors conclude from their experiments that the law of Wiedemann and Franz holds for pure metals and good conductors, but not for alloys having a high electrical resistance.

Alloys in Magnetic Fields. Beattie. Lond. *Elec. Eng.*, Feb. 21; a brief note referring to a paper in the *Proceedings of the Royal Society of Edinburgh.*—In his paper he discusses the behavior of various alloys in a steady magnetic field; the variation of the resistance of bismuth is known to be great and it was found that in alloys it was greatest in those which contained the most of that element; in all cases the variation was an increase; no variation was observed in antimony-zinc and antimony-cadmium; the decrease of resistance in the nickel plate placed perpendicular to the lines of force, and the increase in antimony and tellurium are proportional to the square of the magnetization; it appears that the direction of "the transverse effect in a conductor follows the thermo-electric series of metals from bismuth to silver, giving a negative effect, while those from zinc to tellurium give a positive effect; cobalt is an exception."

Electromagnetism. Jones. Lond. *Elec.*, Feb. 21, abstracted briefly from *Wied. Ann.*, No. 2.—He discusses the magnetic carrying power and electromagnetic tension and claims to have driven the induction up to 74,200 units.

ELECTRO-CHEMISTRY AND BATTERIES.

Primary Battery. Levetus. Lond. *Elec. Rev.*, Feb. 21.—A brief description of a recent patent to which the belief is added that the arrangement will doubtless answer as well and perhaps a trifle better than some others, supposing there was a demand for large primary batteries, which is doubted. The electrodes appear to be iron and carbon; the containing cell is divided into three compartments, the middle one of which contains the iron and carbon elements, while the other two serve as reservoirs for the exciting liquid; the carbons are made of hollow rods which are sufficiently porous to allow the hydrogen to pass through the walls of the tube; the liquid consists of a solution of any salt or acid with a base of chromium, in conjunction with ordinary acids; the iron is in sulphuric acid.

Cadmium Accumulator. *L'Elec.*, Feb. 22; a very brief description.—The positive plate is like those in the ordinary accumulator, but the negative is an alloy of lead, antimony and cadmium; the liquid is a solution of cadmium sulphate to which is added 10 per cent. of sulphuric acid; during the charge cadmium is deposited, and during the discharge it is dissolved; it is claimed that hereby the sulphating of the negative plate is avoided; on open circuit the voltage is 2.3, and on discharge, 2.2 and 2.15; at normal rates the capacity is 54 watt-hours per kgm of plates.

The Cyanide Process in Metallurgy. Lond. *Elec. Rev.*, Feb. 21.—A note calling attention to and recommending highly an important paper in the *Zeit. Phys. Chem.*, Vol. 17, page 513; it appears to be of a theoretical nature, and gives equations for the dissociation.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Static Charges on Testing Instruments. Stottner. Lond. *Elec. Rev.*, Feb. 21.—In certain commercial ammeters there was a complaint that sparks passed almost continuously between the pointer and the scale; repeated attempts to insulate the instrument or parts of it failed to prevent this charge and the resulting attraction between the pointer and the scale; the base plate could not be earthed without risk, as the current was a 2500-volt alternating current; he tried a Geissler tube in order to produce a silent discharge and the experiment proved to be a perfect success. The scale is in metallic contact with the base plate while the solenoid with the indicating device is insulated from it; if a 2-inch Geissler tube is connected between the base plate and the insulated solenoid, the static charges are easily neutralized without interfering with the insulation of the instrument. He observed a similar phenomenon some years ago with a Siemens torsion galvanometer, between the torsion button and the outer ring which holds the glass scale; the charging of these parts affected the damping device and correct readings became impossible until the button and the ring were connected with a piece of tinfoil.

Measurement of Dielectric Constants. Nernst. Lond. *Elec.*, Feb. 21; abstracted briefly from *Wied. Ann.*, No. 2.—He describes his telephone method consisting of a bridge with two equal resistance branches, a dielectric in the third and a variable capacity and resistance in parallel, in the fourth branch; the source is a high-frequency induction coil and the detector is a telephone which is reduced to silence as soon as the variable resistance and capacity are the same as those of the dielectric; the method is said to be very convenient and perfect; when compared with the electrometer method the needle was suspended by a quartz fibre and bodily immersed in the dielectric "between terminals surrounding it in semi-elliptical arches"; the deflection of the insulated needle, which is charged by induction, is proportional to the dielectric constants; the two methods gave highly consistent results.

Measurement of High Potential Differences. Lond. *Elec.*, Feb. 21.—A brief note calling attention to a recent Royal Society paper by Leake, Leventhorpe and Whitehead, describing some methods for such measurements; the first part is devoted to measurements in terms of absolute electromagnetic units with special reference to the calibration of electrostatic volt-meters; it is thought probable that with measurements made in the way described voltages up to about 2000 are correct to about $\frac{1}{10}$ of a per cent.

New Form of Resistance. Voigt. *Elek. Zeit.*, Feb. 20.—An extract from a lecture in which he stated having tried, with good results, resistances made of gold, silver or platinum on glazed porcelain, in the form of thin layers, as used for decorating purposes; a resistance for dimming an incandescent lamp gave good results, the current density being calculated to be 300 amperes per sq. mm; it is proposed to use this system for electric cooking.

Producing a Self-Indication. Wien. Lond. *Elec.*, Feb. 21; abstracted briefly from *Wied. Ann.*, No. 2.—It is said to be a promising alternating apparatus for producing any self-induction from 5000 to 10^{10} cm, and consists "of a fixed circle of several coils for step-by-step changes and a concentric coil movable about a diameter to fill up the intervals." Nothing further is given in the abstract.

Unit of Light. Spies. *Zeit. f. Elek.*, Feb. 15.—A brief abstract of a lecture in which he states that as soon as it will be possible to determine the relation between the light and the dark rays, on an illuminated surface, it will be possible to have a mathematically exact unit of light; he showed that with the aid of the bolometer the heat of a platinum plate can be determined very accurately, and that through the means of this instrument it may be possible to arrive at an absolute unit of light. He also showed a mercury arc light in a vacuum tube in which occasional, purely luminous rays were produced, as shown in the spectrum, and this he believes indicates the possibility of obtaining a light without heat.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Cardew's Vibration Sounder. *Elek. Zeit.*, Feb. 20; an abstract from an article in the *Jour. Teleg.* describing some tests in India with this apparatus; it is intended to be used on lines which are temporarily in a very bad condition with respect to the insulation and on which the usual telegraph apparatus cannot be used; it was shown that with a speed which was sufficient, good and clear signals can be obtained over a cable 53 km long, when the cable has a leak through the earth or is completely broken; if this apparatus is combined with the Melhuish method of making the circuits, the speed will become as great as that with the usual Morse apparatus on a good line.

Telephone Circuits. *Elek. Zeit.*, Feb. 20.—A brief, illustrated description of a system which has been in use by the German Post Office Department for several years with good results. Connections between two subscribers are generally made so that a signaling apparatus is placed in circuit to receive the signal that conversation has ended; the effect on the electromagnet of this apparatus on the currents is negligible under ordinary circumstances, but when single circuits are connected with double circuits or in connecting several single circuits through the intermediary of different stations, it is desirable either to omit these electromagnets or to connect them to earth as branch circuits; in the present system the latter is done.

Disturbing Currents in Telephone Lines. Pierard. *Bull. l'Ass. Ing. El Montefiore*, Jan. 24.—He discusses the question of the mixture of currents in aerial lines with special reference to the theories of Mueller (which have been described in these columns), with which he does not agree.

Cable Defence Scheme. Snell. Lond. *Elec. Rev.*, Feb. 21.—A reply to the criticism of his scheme (*Digest*, last week); he makes some corrections

and defends his original proposition; among other things he believes that if the cable was paid out as usual the risk of injury would be very much too great; as it is to be thrown overboard, as it were, the maximum strain is not when running at a high speed but when the vessel is going slowly; he questions whether it would be safe to rely on paying the cable out without any mechanism.

Bell. Elec. Tech., Feb. 15.—An illustrated description of an electrical vibrating bell which is intended to overcome the objections made to the harsh sound due to its being struck with a hammer; in the present form the bell is of iron, part of it forming the armature of the magnet which is in the inside; on the outside, opposite the poles of the magnet, is placed a circuit-breaker; the bell is therefore put in vibration by the magnetic attraction as distinguished from being struck by a hammer.

MISCELLANEOUS.

Disintegration of Organic Tissue by High-Tension Discharges. Lond. *Elec. Rev.*, Feb. 14.—A brief description of the recent experiments of Dr. PARSONS, with a view to applying the electric discharge for the destruction of malignant tumors, dispensing altogether with the use of the knife. He discovered that organic tissue can be disintegrated throughout the path of the current without appreciably heating the caustic action, by the use of discharges from an induction coil; a constant current applied to fibroid tumors is confined to a small area, and the distribution is greater than is necessary, for which reason he experimented with sudden discharges; platinum electrodes were inserted into pieces of beef, and it was found that stripped muscular fibre could be completely disintegrated in the space between the two poles; the destruction was not quite as complete in the axis of the ellipsoidal space between the poles as nearer the surface; within certain limits the effects of successive discharges were cumulative for obtaining these effects; he thinks that voltage is more important than current.

Lightning and Blast Furnaces. Lond. *Elec.*, Feb. 21.—A brief abstract from the *Engineer* referring to observations at some iron works on the Rhine; records show that during eight years the blast furnaces were struck three times; while out of 10 lightning flashes only one passed through the lightning conductor, most of the others striking piles of pig iron; in one case it struck the furnaces, which trembled and rattled, but no damage was observed, nor had the iron charge been affected; it was thought that the reason the lightning entered the furnaces instead of the lightning conductors was the pillar of smoke, dust and water vapor, which rose to a height of 40 metres above the furnaces, and which is thought formed a good conductor, while the other end of the furnaces was earthed through the pig bed.

New Book.

COMPRESSED AIR. Practical Information upon Air Compression and Application of Compressed Air. By Frank Richards. New York: John Wiley & Sons. 203 pages. Price, $1.50.

So many claims have been made by the advocates of compressed air, of its high efficiency and economy when utilized for the transmission of power, especially over considerable distances and in comparison with electricity, that we have read this latest addition to the literature on the subject with more than usual interest.

We lay the book aside with a feeling of disappointment, for although the author has attempted, so far as he goes, to stick faithfully to his determination to "tell the straight truth," he has stopped short where so many others have stopped before, and fails to give either examples of complete compressed-air power-transmission plants, with efficiencies and economies, from the prime mover at the power-house to the driving pulley at the factory, or data from which reasonably accurate comparisons can be made with other powers.

The book is written in a bright, clear and interesting manner; abounds in explanatory diagrams and formulas; and contains a large number of well-arranged, useful tables. Beginning with definitions and general information, the author goes on to explain the method of ascertaining the power consumed in compressing air and the power available after compression; the comparative efficiencies of one- and two-stage compression; the losses during compression and transmission; the power value of compressed air; and the various uses to which it is applied.

Its weakness is its incompleteness and the attempt to reach too wide a circle of readers. While each will find much of interest and value, the layman will object to the tables and dearth of illustrations; the statistician to the absence of general data; the compressed air engineer to the elementary character of the subject-matter, and the electrical engineer to the lack of facts and figures relating to ultimate efficiencies.

The extreme inefficiency of most of the present applications of compressed air is emphasized rather than excused by the reiterated statement that it is "cheap at any price," and one cannot but feel surprised that with so wide and important a field of usefulness and such promise of further extension, the advance in the line of efficiency, outside the compression itself, has been so insignificant as to be almost inappreciable.

The table of some 200 applications of compressed air is interesting, and its perusal emphasizes the fact stated by the author that compressed air and electricity have each their own peculiar field of usefulness and are little liable to engage in active hostilities over disputed territory.

Trolley Ear.

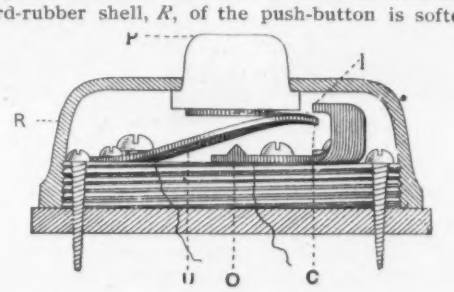
The accompanying show in section and elevation the Walker trolley ear, manufactured by the Ohio Brass Company, Mansfield, O., through an exclusive arrangement with the patentee. The claims made for this support are its perfectness of design, simplicity in handling, and the fact that it is practically non-sparking when in use. By its peculiar design this type of ear holds the trolley wire securely in place without any possibility of its changing from its normal position; it is durable and lasting, for the body of metal upon which friction is brought to bear by the trolley wheel is of sufficient thickness to last a number of years. Its principal feature and the one which recommends it most strongly to engineers is that the same effect is obtained by its use as that of the regular soldered ear, no obstruction being offered to a free passage of the trolley wheel,

THE WALKER TROLLEY EAR.

and in consequence no sparking results from its use. It is easily and quickly applied in position on the line, the trolley wire being bent to the proper curvature by the special tool provided for this purpose. The wire is then slipped into position between the opposing lips of the ear, and the lugs at either end and centre are formed over the wire. If it is necessary to adjust the ear, the lugs can be bent back and the wire removed for straightening and replacing. This ear is already in extensive use on some of the largest electric systems in the country; in a list before us we note that it has been adopted by roads in Virginia, New York, Iowa, Georgia, Kentucky, Massachusetts, Pennsylvania, Indiana and Alabama.

Automatic Thermostat and Push-Button.

The accompanying illustration shows an automatic thermostat and push-button now being placed upon the market by the Automatic Thermostat & Push-Button Company, 312 Neal Building, Baltimore. Exteriorly the combination has the appearance of an ordinary push-button, the shell being of hard rubber. Referring to the illustration, it will be seen that the point marked *I* can make no contact with the spring, *U*, until the hard-rubber shell, *R*, of the push-button is softened by the



THERMOSTAT AND PUSH BUTTON.

effects of an elevated temperature. The rubber shell then gives way and allows the spring to rise until the points *I* and *C* are brought together, which completes the electric circuit and sounds an alarm. The shell, *R*, is also made of metal, in which case the push-button, *P*, is of rubber, which becomes soft at a dangerously high temperature and causes the alarm-contact to be made. In ordinary use, in connection with an electric bell, pressure on the push-button causes the spring to make contact at the point *O*.

Portable Electric Propeller for Boats.

In an article in these columns last week on the ingenious electric propelling arrangement for small boats made by the Electric Boat Company, 136 Liberty Street, New York, a serious error appeared in connection with the weight of the batteries. It was stated that power was furnished by "twelve cells of storage batteries weighing 50 pounds apiece and upward, according to the type." This should have read, "twelve storage cells, arranged in batteries of three cells, each battery weighing 50 pounds and upward, according to the type." In other words, the entire weight of storage batteries is only 200 pounds instead of 600 pounds, as implied in the first statement. A primary battery may replace the storage battery, the weight in this case being still less.

Double Reciprocating Square Piston Engine.

The extremely compact type of engine shown in the accompanying illustration is unusually interesting on account of the ingenious mechanical principles involved in its design. As a steam engine, aside from questions of design, the makers, the Dake Engine Company, Grand Haven, Mich., claim that five years' experience with many engines in constant use and at high speeds has demonstrated that in reliability, and especially durability, it is not exceeded by any of the types of usual design. On account of its compact form, this engine is claimed to be particularly suited for running ventilating fans, centrifugal pumps, incandescent lighting dynamos and saw mill carriages. Being strongly built, self-contained and not affected by ordinary jars, it also gives reliable service when used to run smoke-consumers and head-light or other dynamos on railway trains, and when employed for various auxiliary purposes aboard vessels.

Fig. 1 illustrates the engine complete, and Figs. 2 and 3 show the working parts. In Fig. 2 the pistons are removed, showing the interior of the case with the crank in position, this latter revolving in the chamber shown in the back of the case in the central cut. This chamber is supplied with oil and water from an opening in its back, thus securing lubrication to every part of the interior of the engine.

The pistons are shown in Fig. 3, the crank being carried to the extreme right hand of the case. Both side pistons, as will be seen, have a horizontal movement sliding from side to side, and at the same time an inner piston to which the crank pin is attached has a vertical or up and down motion, the two movements imparting rotary motion to the crank. Steam is admitted through channels in the cover, one opening into a central aperture and another into an annular opening on the inside of the cover as shown in Figs. 2 and 3. Four channels are cored through the inner piston, one leading to the top and another to the bottom, and one to each end of the inner piston, the latter also, leading through the ends of the outer piston. Four parts corresponding with the channels in the interior of the inner piston are cut through the face (or side next to the cover) of the inner piston in the proper position to register over the central aperture in the cover. The steam entering the port in the inner piston, through the central aperture of cover and reacting against the side of the case, imparts motion to the crank, the port passing over the annular ring and exhausting into it after having done its work. There are four distinct impulses of steam to each revolution of the crank, and the arrangement of the ports to the crank are such that each impulse of steam is given at a point where it has the greatest power. The expansion of steam is secured in the passage of the ports of the inner piston over the central aperture in the cover.

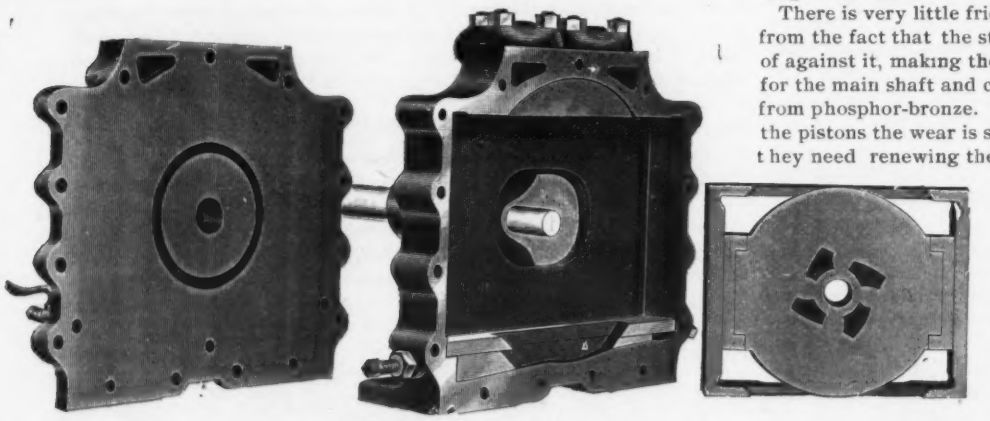


Fig. 2.—Working Parts of Engine.

With the reversing engine, the channeling on the cover and in the piston is the same as in the engine built to run one way, but the ports in the inner piston are shaped so that they register over both the central and annular openings, using each alternately as steam and exhaust. The ports on the top of the case being fitted with a suitable valve which connects the channels leading to the working parts of the engine, motion is given to the engine either to the right or left as desired. The reversing engine is the same as a stationary engine, only with reversing throttle instead of governor.

Provision is made for taking up the wear of the working parts of the engine in a simple and effective manner. The inner piston is fitted with phosphor-bronze slides that admit of a thin piece of tin or sheet iron being inserted when the wear is sufficient to allow it. A wedge-shaped plate on which the lower slide rests is arranged with set screws on the outside of the case (Fig. 2), which keeps the piston steam tight, top and bottom. The packing of the cover to the pistons is effected by thin copper joints placed between the edge of the case and cover. The pistons are made so that they are slightly thicker than the case they occupy, and enough copper strips are put in to fill up the space; these joints are removed one at a time as the pistons wear down, and where it is seen that repacking is needed and a copper joint is too much to take off at one time, a piece of thin paper to take its place will repack the cover perfectly. The repacking of the cover as above described, and replacing the nuts or cap screws (as found on the different sizes of engines), evenly, is the only point about the engine that requires careful attention and judgment on the part of the person in charge, and repacking is not required except at long intervals.

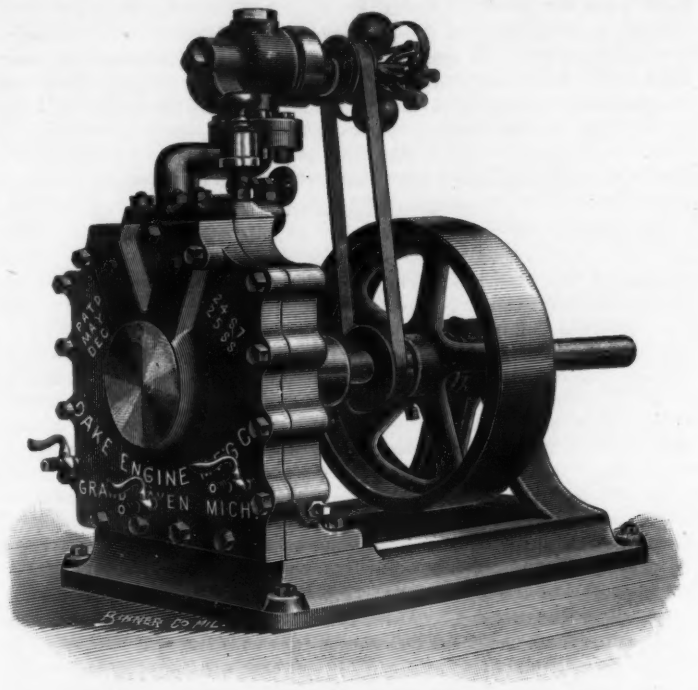


Fig. 1.—Dake Engine.

There is very little friction, and consequently slight wear on the pistons from the fact that the steam pressure is inside of the inner piston, instead of against it, making the pistons similar to balanced valves. The bearings for the main shaft and crank pin are in the form of bushings and made from phosphor-bronze. From the manner in which steam is applied to the pistons the wear is slight compared with the ordinary engine. When they need renewing the worn ones are driven out and the new bushings driven to place, which can be done by any good machinist at a small cost to the purchaser. The crank and pin are made from the best quality of cast steel, and the shaft, which is machinery steel, is shrunk into the crank in a solid manner. The outer piston is also made from best quality of cast steel. Every part of the interior of the engine is fitted with the greatest care. The inner face of the cover and all of the working parts of the engine are ground surfaces, made with tools especially designed for the manufacture of this type of engine, thus ensuring that the engine is practically steam tight from the start. Everything about the inside of the engine is made interchangeable, and can be duplicated in case of accident on short notice.

Transmission of Power in Mexico.

A contract has recently been placed with the representative of Messrs. Siemens & Halske, in Mexico, for the transmission of water power from falls at Tenancingo to the City of Mexico, the Federal District and neighboring States.

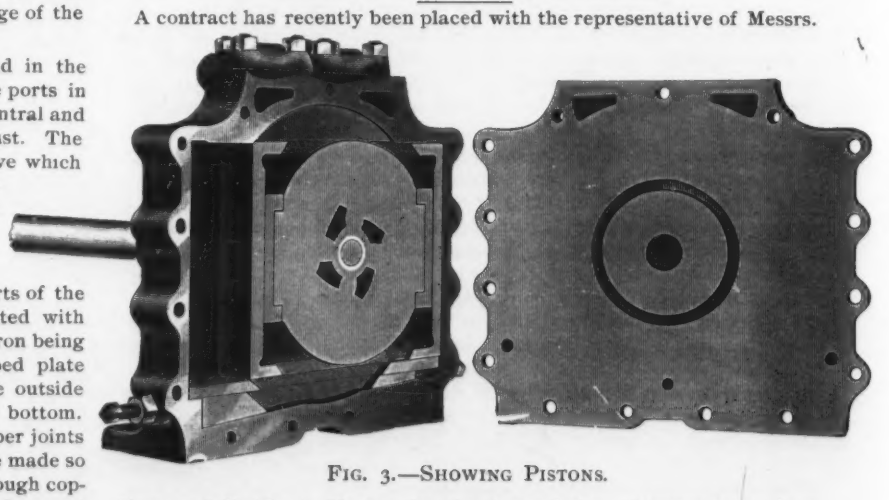


Fig. 3.—Showing Pistons.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, March 7, 1896.

THE PREVAILING DULLNESS this week among listed stocks has been reflected in almost absolute stagnation in outside securities. Little trading has taken place, and in the price of many issues no change is recorded. The small activity shown was confined almost entirely to the tractions.

	Par.	Bid.	Asked
ELECTRICAL STOCKS.			
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	95	96
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	131	133
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	28¼	28¾
Electric Storage, pref	100	28½	29
General Electric	100	34⅛	34¼
General Electric, pref	100	60	62
Westinghouse Consolidated, com	50	28	28½
" " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	202	202½
American District Telegraph	100	33	40
American Telegraph & Cable	100	91	95
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	60	61
New England Telephone	100	88½	89
Postal Telegraph-Cable	100	85	86
Western Union Telegraph	100	..	..
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	17½	17¾
Brooklyn Rapid Transit		23¼	23⅜
Brooklyn Traction	100	9½	10
" " pref	100	51	53
Buffalo St. Ry	100	70	72
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	49	50
Hestonville	100	48½	49½
" pref		..	63
New Orleans Traction	100	17	19
" " pref	100	63	66
North Shore Traction	100	30	32
" " pref	100	80	82
Rochester St. Ry	..	28	33
Steinway, Ry	..	49	..
Union Railway (Huckleberry)		99	102
Union Traction, rcts $5 pd	..	14⅞	15
West End, Boston	100	68	68½
" " pref	100	88	90
Worcester Traction	100	16	19
" " pref	100	87	90
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	79	81
Buffalo St. Ry. 1st con. 5s	100	104	107
Cleveland Elec. Ry. 1st mtge 5s	100	101	103½
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	98	101
Union Railway (Huckleberry) 1st mtge 5s		103	105½
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

BROOKLYN CITY RAILWAY stock continues inactive but firm. The suit brought by P. H. Flynn, to declare invalid the lease of the Brooklyn City by the Brooklyn Heights Company, which had been pending for some months, has at last been dismissed. An appeal will, however, be taken. To offset this favorable decision there has been some talk of a general street railway strike throughout the country. No definite action, it is said, has thus far been taken. The gross earnings of the Heights system for the eight months ending Feb. 29 were $2,882,575, against $2,773,348 for the same period a year ago.

BROOKLYN TRACTION continues to be the most active stock on the list. The publication of the terms of the Brooklyn-Nassau lease has not tended to strengthen the stock, however, and sales continue to be made between 9¼ to 9¾. The preferred is very dull around 52. If substantially all the Brooklyn Traction stock is not deposited before March 16, the committee has reserved the right to declare the plan inoperative.

BUFFALO RAILWAY.—The strongest stock in the traction list has been Buffalo Railway, which has advanced during the week from 70 to 73 bid. This strength is attributed to rumors prevalent in Wall Street, to the effect that the Buffalo Traction interests had been bought out by the Buffalo Railway Company and that consequently the recent contest for territory in Buffalo had terminated. Both issues of bonds, the Consols and Crosstowns, have advanced in sympathy, but as the floating supply is small the trading is limited.

CITIZENS' RAILWAY, (Indianapolis) stock has again advanced on reported inside buying.

NEW ORLEANS TRACTION.—The report that the option would be exercised, which a syndicate now holds, to purchase about $1,100,000 bonds of the New Orleans City and Lake & Crescent City Railway has tended to strengthen New Orleans Traction securities. Sales of the preferred stock are quoted around 66, and of the common at 17½.

NORTH SHORE TRACTION continues strong but inactive. The company has declared its regular semi-annual dividend of 3 per cent. on the preferred stock.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, March 9, 1896.

SMITH & PATTERSON, successors to Smith, Herlitz & Co., importers of Swedish iron for armature and transformer cores, have removed from 7 Warren Street to 256 Broadway, just below Warren.

THE SOLAR ELECTRIC COMPANY on March 5 filed a petition for dissolution as a corporation. The court appointed Charles Donohue, Esq., 203 Broadway, as referee, who, at his office on June 8, will hear all persons interested in the said corporation as to reasons, if any, why it should not be dissolved.

C. O. MAILLOUX, consulting electrical engineer, has removed his office from 25 William Street to the American Tract Society Building, 150 Nassau Street. In his new quarters with enlarged space, a larger staff of assistants and otherwise improved facilities, Mr. Mailloux will continue in the successful practice of making a specialty as heretofore, of advising, assisting and serving architects, builders and owners in furnishing plans, specifications, supervision, tests, etc., for electric plants, installations and outfits of all kinds for public and private buildings, central stations, etc.

MR. THOS. F. O'CONNOR, who has been nine years connected with the Standard Underground Cable Company, has just resigned from that company to accept the position of assistant general manager of the National Underground Cable Company. Mr. O'Connor has been in the underground cable business from its infancy, has seen it grow to its present proportions, and has added much in that growth. Outside of his broad experience in the underground cable business, in which he is an acknowledged expert, Mr. O'Connor is well known as an inventor in mechanical as well as electrical branches, and has also the rare advantage of having taken a three years' law course in the University of the City of New York.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., March 7, 1896.

MR. A. ARTHUR ZIEGLER, president of the Ziegler Electric Company, Boston, was able to visit his office this week for the first time after eight weeks' confinement to his home, incident to his serious burning accident, from which it is a pleasure to report his complete recovery, and over which his many friends rejoice.

THE KNEELAND REFLECTOR COMPANY, 24 Travers Street, Boston, reports that the popularity of the ground-glass bottom reflectors, as manufactured by it, continues undiminished. In reflector shades for incandescent lights Mr. Kneeland is a pioneer and much of their present state of perfection is due to his early experimental work.

MR. JOSEPH W. COLES, identified with the Boston Electric Light Company as electrical engineer, and Miss Fanny B. Hoyt, of Portsmouth, N. H., were quietly married at the latter's home on Feb. 4, and are now residing in Boston. Our congratulations are joined with the many friends of Mr. Coles and his charming wife for the fullness of happiness and prosperity.

THE RECENT STORMS AND FRESHETS have been of a particularly destructive character in New England, and have occasioned enormous losses to its manufacturing and electric lighting and electric railway interests. In some instances the destruction was absolute, and the exceptions were few indeed when the electric lighting and electric railway service was not affected to an extent which necessitated suspension of operations.

THE NEW ENGLAND ELECTRIC SUPPLY COMPANY, Boston, has been appointed sole New England agent for the Crocker-Wheeler Electric Company, of New York. A good selection by a good company. Messrs. J. Hally Craig and A. M. Rantoul, of the late firm of Cumner, Craig & Co. (which firm by the way, having expired by limitation, was recently dissolved by mutual consent), have associated themselves with the New England Electric Supply Company, and in connection with its officials will continue to push the Crocker-Wheeler apparatus, with which they have been especially identified for the past three years.

THE ELECTRIC POTENTIAL, Boston, held its regular meeting and dinner at Young's Hotel, Thursday evening, March 5. "The Legal Status of Electrical and Gas Enterprises in Massachusetts" was the topic discussed, a

decidedly valuable and interesting paper upon the subject having first been read by that able legal luminary, Mr. Everett W. Burdett, who is also counsel for the Massachusetts Electric Lighting Association. Important historical and legal facts were presented by Mr. Burdett commanding the closest attention and interest from those present, and the discussion which ensued by Chairman Forrest Barker, of the Gas and Electric Light Commission, A. J. De Camp, of the Brush Electric Light Company, Philadelphia; George B. Neal, of the Charlestown Gas & Electric Light Company, H. H. Fairbanks, of the Worcester Electric Light Company, and Charles F. Prichard, of the Lynn Gas & Electric Company, were equally valuable and instructive. In fact the meeting generally was of unusual interest and most gratifying to President Frank Ridlon. About 75 were present and several new members were elected. The annual meeting will occur early next month, and a very important paper is expected from a gentleman so prominent as to command even a deeper interest and larger attendance. The membership of the Electric Potential is well distributed throughout New England, and thoroughly representative of the electrical and gas interests.

Washington Notes.

WASHINGTON, D. C., March 6, 1896.

THE RESOLUTIONS which have been introduced in Congress by Representative F. C. Layton, of Ohio, pertaining to the Ohio Telephone Exchange Association, representing 27 companies, with 8000 subscribers, which urges Congress to appropriate a sufficient sum of money to enable the Attorney-General of the United States to prosecute the suit now pending in the United States Supreme Court, wherein the United States is plaintiff and the American Bell Telephone Company are defendants, has been referred to the Committee on Appropriations.

REPRESENTATIVE GROUT, of Vermont, has introduced a bill in Congress to authorize the extension of the lines of the Potomac Light & Power Company. The bill directs that the company shall be allowed to extend their lines for the generation of light, heat and power. All construction shall be under supervision of the District Commissioners, and no overhead wires shall be used within the city limits. Outside of the city, where overhead wires shall be used, provisions will be made for at least four wires, and the commissioners may use the same, free of cost, for telegraph, telephone or fire alarm service. The company also agrees to allow the commissioners a duct four inches square, and as long as their lines may be, free of charge. All ducts are to be kept in good repair, and if the commissioners desire, the company will build ten extra ducts to be rented to other parties. The company would light the streets with arc lights of 1000 candle-power for one year or more at the rate of $100 per year. The lights would burn from sunset to sunrise every night in the year. The company would charge private consumers 10 per cent. less than the other companies. If at any time the government wants to own the plant, the company will sell out for what it cost.

THE DISTRICT COMMISSIONERS finished their statement this week to the Senate regarding the permits which have been issued since 1888 for the erection of overhead wires in the District. The object of the Senate resolution was to extract from the Commissioners a statement about the permit granted the Potomac Electric Light & Power Company to erect a pole line across Mount Pleasant. Regarding the permit, they say: "Neither the act approved July 18, 1888, nor any subsequent acts of Congress prohibit the erection of overhead wires in the alleys in the City of Washington, nor the erection of overhead wires in any part of the District of Columbia outside of the said city." The Commissioners have submitted a substitute bill to Congress for the bill now pending to grant to the Potomac Light & Power Company the right to erect the pole line. Mr. Crosby, the president of the company, tried to get the Commissioners to approve his bill, and in submitting a substitute for it they say: "As the Commissioners understand the situation, the company, finding its hands tied and its property and projects jeopardized, asks for Congressional authority to extend its additional lines, erected under permits, and offers to provide certain privileges and submit to certain conditions as compensation therefor. Among such privileges and conditions are the free use of its conduits and poles, where poles are allowed, as along country roads and unimproved suburban streets, for public wires, the right of purchase by the public of its conduits upon specified and reasonable terms, the furnishing of public arc lights at a maximum price of $100, where existing law makes the maximum price $146, and the private lighting at not more than 10 per cent. less than rates prevailing in December, 1895."

THE FOLLOWING BILLS, which will prove of interest to electricians, have recently been presented to Congress: Senator Pugh, of Alabama, has a bill before the Senate authorizing the private use of the water-power of the Coosa River, in Alabama, to H. G. McCall and his associates for the purpose of generating electricity, and for manufacturing purposes.—Representative Hooker, of New York, has presented to Congress a bill to amend an act to authorize the Interoceanic Railway Company to construct and operate railway, telegraph, and telephone lines through the Indian Territory.—A bill to protect State anti-gambling laws from nullification through interstate gambling by telegraph, telephone, or otherwise has been introduced in the House by Representative Gillett, of Massachusetts.—Representative Clark, of Iowa, has a bill in Congress extending one year the time wherein the Des Moines Rapids Power Company shall begin work.—Senator McMillan, of Michigan, has introduced a bill in the Senate authorizing the laying of subways in the streets, roads, avenues and alleys of the District of Columbia, and providing for placing the present overhead wires therein. The bill has been referred to the Committee on the District of Columbia.—Senators Proctor and Bacon gave a hearing last week to advocates of a bill introduced in the Senate by Senator McMillan to incorporate the Columbia Telephone Company. Appearing in the interest of this bill were Major Butterworth, John A. Baker, T. A. Lambert, T. G. Daniel and W. G. Wassaman.—Senator McMillan, of Michigan, has introduced a bill in the Senate to authorize the extension of the lines of the Potomac Light & Power Company, a corporation now engaged in the business of selling electric current for various purposes in the District of Columbia and in the State of Virginia. The bill has been referred to the Committee on the District of Columbia.

Western Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., March 6, 1896.

MR. A. H. PEASE, secretary and treasurer of the Hart & Hegeman Manufacturing Company, of Hartford, Conn., was in Chicago this week for a short visit.

MR. W. CLYDE JONES has just opened an office for the general practice of law at 1107 Title and Trust Building, Chicago. He will give special attention to the practice of law in general, also to patent law and to civil causes, involving electrical, mechanical and similar technical matters.

THE ELECTRIC APPLIANCE COMPANY is gratified with the success of the "Baby" knife switch, which has leaped into public favor with about the same rapidity that the new "baby" usually does. The switch is now made in round and square bases, and from 15 to 25 amperes, single and double pole.

ROTH BROS. & CO., 30 and 34 Market Street, Chicago, report a decided improvement in business for the month of February, and have some promising business in sight for their dynamos and motors. Roth Bros.' dynamos and motors have up to date given entire satisfaction wherever they have been installed.

THE METROPOLITAN ELECTRIC COMPANY reports recent large sales of P. & B. tape and compound. The Spring construction has begun rather early. It is also receiving large orders for ship-cored carbons, another specialty of the Standard Paint Company, for which the Metropolitan Electric Company is the Western agent as well.

MR. F. E. DRAKE, late general agent for the Standard Electric Company, has recently joined the firm of Messrs. W. D. Ball & Co., consulting electrical and mechanical engineers of 1625 Monadnock Block. Mr. Drake's lengthy commercial and practical experience as to the requirements of central stations, etc., should make him invaluable to his business and clients.

MR. WILLIAM M. PORTER, representative of the Lafayette Engineering & Electric Works, of Lafayette, Ind., paid a short visit to the Chicago office of THE ELECTRICAL WORLD this week. He reports the outlook for business for his company this season as most encouraging. Mr. Porter has been quite busy of late traveling through important towns and appointing new agencies to sell his standard multipolar machines. The president of the above company, Mr. C. B. Robertson, is one of the most progressive men in the State of Indiana. He has quite a reputation as a financier, and under his management his company has already overcome a number of important obstacles in the construction of a new multipolar type, which is about to be placed on the market.

General News.

New Incorporations.

THE FUCHS DRY CELL BATTERY COMPANY, New York, N. Y., capital stock $100,000, has been formed by H. J. Katz, New York City; J. V. Palvey and Arthur Barrington, for the purpose of dealing in electrical batteries, instruments, etc.

THE MASSACHUSETTS FAN COMPANY, Boston, Mass., has been formed by O. E. Weller, president; F. B. Witherbee, treasurer, and A. S. Kellogg, to manufacture and sell fan wheels, electrical apparatus and steam engines. Capital stock, $30,000.

THE CHESTER & MARPLE ELECTRIC RAILWAY COMPANY, Chester, Pa., capital stock, $72,000, has been formed by C. R. Maguire, Wayne, Pa.; Josiah Smith, Chester, and William I. Shaffer, Chester, for the purpose of building an electric railway.

THE ELECTRIC DEVICE COMPANY, Chicago, Ill., has been formed by E. C. Knowles, Walter S. Holden and Forrest Hopkins, for the purpose of manufacturing and selling electrical and mechanical devices, signs and appliances. Capital stock, $10,000.

THE MANAOS ELECTRIC LIGHTING COMPANY, Norfolk, Va., capital stock, $2,000,000, has been incorporated by Charles H. Flint, Alfred De Buys, New York City, and J. W. Willcox, Norfolk, Va., for the purpose of constructing and maintaining electric plants.

THE EAST SIDE ELECTRIC COMPANY, Detroit, Mich., has been incorporated by A. Jacobs, F. R. Hamburger, Samuel L. Goldstein and John Robertson, Detroit, Mich., for the purpose of manufacturing and selling electricity for light and heat. Capital stock, $20,000.

THE ELECTRIC LAMP & NOVELTY COMPANY, New York, N. Y., capital stock, $10,000, has been incorporated by C. R. Fowler and E. S. Lawrence, Jr., New York City, and W. R. Powell, for the purpose of making and selling incandescent lamps, electrical novelties, etc.

THE MASSIE LIGHT & POWER COMPANY, Charlottesville, Va., capital stock, $50,000, has been formed by W. J. Ficklin, F. B Trieber, J. L. Waters, S. M. Keller, Charlottesville, Va., and C. H. Harmon, New York City, for the purpose of erecting and operating an electric light plant.

THE LESCHEN-MACOMBER-WHYTE COMPANY, Chicago, Ill., capital stock, $2500, has been formed by Frank B. Macomber, George S. Whyte and Henry J. Sampson, for the purpose of manufacturing, selling and dealing in wire, wire rope, cordage, railway and electrical supplies.

THE KINGSTON & LAKE KATRINE RAILWAY COMPANY, Kingston, N. Y., has been organized by Richard Lenahan, Kingston, N. Y.; H. W. Martin, Bennington, Vt.; and Henry McMillan, Kingston, for the purpose of building a street railway in Ulster County. Capital stock, $100,000.

THE COLUMBIAN GAS & ELECTRIC STOVE COMPANY, Royersford, Pa., has been incorporated with a capital stock of $25,000, by Adam Grander, Josiah J. Nix and William P. Grander, Royersford, Pa., for the purpose of manufacturing gas and electric and other stoves and castings.

THE FREDERICK ELECTRIC RAILWAY COMPANY, Winchester, Va., has been incorporated for the purpose of operating electric railways in the County of Frederick. The promoters are H. H. Baker, George W. Hadedox, W. H. Sale, S. B. Sale and P. H. Gold. Capital stock, $100,000.

THE MARTIN SUPPLY & LIGHT COMPANY, Xenia, O., capital stock, $50,000, has been formed by John P. Martin, Charles Darlington, Henry Fetz, A. Spahr and Dennis Carroll, for the purpose of furnishing electric light and power, manufacturing and supplying gas, ice and furnishing cold storage.

THE HILLEREST AVENUE PASSENGER RAILWAY COMPANY, Philadelphia, Pa., has been organized by J. Lowber Welsh, 304 Walnut Street, Philadelphia; William H. Wilmerding, Germantown, Pa., and Caleb F. Fox, Drexel Building, Philadelphia, for the purpose of building an electric railway. Capital stock, $10,000.

THE OAKLAND & LIVERMORE VALLEY RAILWAY COMPANY, Oakland, Cal., capital stock, $3,000,000, has been formed by E. P. Vandercook, Oakland, Cal.; George D. Metcalf, A. D. Wilson, Berkeley; H. H. Pitcher, Livermore, and Rod W. Church, Oakland, for the purpose of building and operating a cable or electric railway.

THE YONKERS & TARRYTOWN ELECTRIC RAILWAY COMPANY, Yonkers, N. Y., capital stock, $750,000, has been organized by J. M. Edwards, New York City; J. H. Ingram, New York City; J. F. Van Mane, Brooklyn, and C. M. Johnson, Yonkers, N. Y., for the purpose of building and operating a railway from Yonkers to Tarrytown, N. Y.

THE WELLBAUM ELECTRIC LIGHT & MANUFACTURING COMPANY, Brookville, O., capital stock, $10,000, has been formed by Ira C. Wellbaum, Valentine Wellbaum, H. H. Riley, O. E. Baker, and O. T. Priser, for the purpose of furnishing electricity for light, heat and power, dealing in electrical supplies, constructing electrical apparatus, etc.

THE CENTRALIA, ASHLAND & LOCUST GAP STREET RAILWAY COMPANY, Ashland, Pa., capital stock, $36,000, has been formed by Thomas R. Pepper and Joseph D. McConnell, Ashland, Pa., and James A. McCarthy, Locust Gap, Pa., for the purpose of building an electric street railway in Centralia, Ashland and Locust Gap, in Schuylkill County.

THE COLORADO SPRINGS & CRIPPLE CREEK SHORT LINE RAILWAY COMPANY, Colorado Springs, Col., capital stock, $1,000,000, has been organized by William R. Benzie, James A. McCormick, Quincy E. Hicks, Lynn S. Atkinson and Francis L. Burton, Colorado Springs, for the purpose of building an electric railway from Colorado Springs to Cripple Creek.

THE J. NUSSDORFER STANDARD BAKING COMPANY, Cleveland, O., has been incorporated with a capital stock of $50,000, for the purpose of doing a general baking and confectionery business and selling surplus steam and electric power. Those interested are J. Nussdorfer, W. H. Nussdorfer, William H. Beavis, Theodore Schmitt and Charles A. Cook.

THE WEST ROXBURY & ROSLINDALE STREET RAILWAY COMPANY, Boston, Mass., capital stock, $100,000, has been formed by Clifford Devens, Roslindale; Willard P. Whittemore, Charles H. Wise, Roslindale; Charles C. Davis, West Roxbury, and Joseph Halstrick, State House, Boston, for the purpose of locating, constructing and operating a street railway.

SOUTHERN TELEPHONE & CONSTRUCTION COMPANY, Tallahasse, Fla., capital stock, $10,000, has been formed by W. L. Moor, F. Willis, Tallahassee, and George W. Schewing, Memphis, Tenn., for the purpose of constructing, maintaining and operating telephone exchanges and electrical plants for light, power and other useful purposes, and to manufacture and deal in electrical supplies.

THE MULTIPLEX ELECTRIC COMPANY, Jersey City, N. J., capital stock, $300,000, has been formed for the purpose of dealing in and operating electrical and other machinery and appliances and operating electric lighting plants. Those interested are Samuel H. Munroe, Louis Hennemeier, Jr., Jersey City; Winfield S. Chamberlin, Bayonne; James Palmer and James N. Braden, Jersey City, N. J.

THE RICHMOND HILL & QUEENS COUNTY GAS LIGHT COMPANY, New York, N. Y., has been incorporated for the purpose of making and selling illuminating and fuel gas and generating electricity for lighting the village of Richmond Hill, N. Y. Those interested are Alexander A. Forman, Brooklyn; E. S. Hobbs, New York City; George Forman, Haverstraw, and Franklin B. Case, New York. Capital stock, $250,000.

THE DENVER CITY RAILWAY COMPANY, Denver, Colo., has been formed for the purpose of purchasing the property of the Denver City Cable Railway Company, the Denver City Railway Company, and the Denver City Electric Railway Company, and building additional lines. Those interested are George E. Randolph, Colin A. Chisholm, Henry F. May, Charles W. Waterman and John F. Heeney, Denver, Colo. Capital stock, $3,700,000.

THE HARRIS MAGNETO ELECTRIC COMPANY, New York, N. Y., has been incorporated in West Virginia for the purpose of manufacturing and selling electrical appliances employed in the treatment of the purification of liquids and other substances. Those interested are George H. Graham, East Orange, N. J.; Harvey C. Ward, Ridgewood, N. J.; Samuel Osborn, Brooklyn, N. Y., and Edgar Tucker, New York City, N. Y. Capital stock, minimum, $500; maximum, $5,000,000.

TELEGRAPH AND TELEPHONE.

EAGLE GROVE, IA.—Eagle Grove is to have a telephone exchange.

ARMSTRONG, IA.—Armstrong is to have a local telephone exchange.

EAGLE GROVE, IA.—A telephone exchange will shortly be installed.

ROCHESTER, MINN.—A telephone exchange is soon to be constructed here.

GHENT, KY.—A long-distance telephone is soon to be established at Ghent.

LEXINGTON, MO.—This town and Cameron will soon put in telephone systems.

CARROLLTON, KY.—A telephone line will be built from Carrollton to Easterday.

SEBREE, KY.—It is expected that Sebree will have telephone connections with Dixon shortly.

WYOMING, N. Y.—The people of Wyoming are agitating the formation of a local telephone service.

GRANTSBURG, WIS.—A telephone line is now proposed from Grantsburg to Trade Lake, in Burnett County.

GLASGOW, KY.—Glasgow Junction is to have telephone connection with Cave City, Glasgow and other points.

MIDDLESBORO, KY.—The Middlesboro & Pineville Telephone Company is to build a new line in the former city at once.

ELECTRIC LIGHT AND POWER.

NEWTON, IA.—The electric light plant here will be enlarged.

BOWEN, ILL.—A movement is on foot to install an electric lighting plant.

LAWRENCEBURG, KY.—An electric lighting plant is to be erected here.

WILLIAMSBURG, IA.—The electric light question is being agitated by the citizens.

JOHNSTOWN, PA.—There is some agitation in favor of a municipal electric lighting plant.

BROADHEAD, WIS.—The Council will call an election to vote on the question of municipal lighting.

BEATRICE, NEB.—The citizens will vote April 7 on the question of issuing $10,000 electric light bonds.

ANITA, IA.—A movement is on foot to install an electric lighting plant. It is thought that this can be done for $7000.

BERRYVILLE, VA.—The Senate passed a bill to empower the town of Berryville to construct an electric light plant.

SUNCOOK, N. H.—It is understood that the Hooksett Electric Light Company will extend its line into Pembroke in the early Spring.

WILKES BARRE, PA.—Hess, Goldsmith & Co., of the silk mills at South Wilkes Barre, has decided to erect its own electric light plant.

AUBURN, N. Y.—A special meeting of the Common Council has been called by Mayor Lewis to consider the question of municipal lighting.

ALBANY, N. Y.—In Greenbush, just opposite Albany, the electric light plant was submerged during the recent floods and the village left without light.

MIDDLETOWN, CONN.—Gustav Loewenthal has commenced erecting a factory for turning out doors, sash and blinds, the motive power of which will be electricity.

COLLEGE POINT, L. I., N. Y.—The Flushing Electric Light Company wants to build a system in College Point, for the purpose of lighting the streets of that village.

ALBANY, N. Y.—At the meeting of the Water Board, Superintendent Bailey was instructed to prepare plans and specifications for an electric light plant to light the buildings of the department.

BUFFALO, N. Y.—Alderman Franklin and others will request the Common Council to direct the Corporation Counsel to draft an act allowing the city to issue $300,000 in bonds for the purpose of buying or building an electric light plant.

NEW DOUGLAS, ILL.—The stockholders of the New Douglas coal mine have received a proposition from parties from Belleville who offered to put machinery in the mine and run it by electricity if given a controlling interest. They offered to light the town by the same electric plant.

GREEN BAY, WIS.—Green Bay and De Pere are to be connected by an electric railway. Work will be begun shortly by the Fox River Electric Railway Company, on an extension of its tracks from their present terminus at Woodlawn Cemetery to De Pere. The power plant will be doubled and the entire cost will be $35,000.

WILLOW GROVE, PA.—A new electric power house is soon to be built by the Union Traction Company, of Philadelphia, to add to the power now required to operate the big trolley system. It is to be located at Willow Grove, the terminus of the Old York Road line. Plans of the building have been drawn, and its construction will be pushed as rapidly as possible.

ALBANY, N. Y.—A plan for the utilization of the water-power at the State dam at Troy is being considered by local capitalists. It is intended to erect an electric plant at Green Island, the power for the dynamos to be furnished by turbine wheels. The power generated can be used to operate the Albany Railway, the Troy City Railway and the Cohoes City Railway as well as the electric car line from Troy to Sandlake.

THE ELECTRIC RAILWAY.

FRANKLIN, N. Y.—Over $6000 has been subscribed in Franklin for the proposed electric road to Sidney.

NORWALK, CONN.—There is a movement on foot to extend the Norwalk Electric Railway to South Wilton.

GREENWICH, CONN.—The building of a trolley road from Greenwich to Portchester will be shortly commenced.

BROOKLYN, N. Y.—In another month the Nassau Railway Company will lay tracks on East Broadway to Canarsie.

TEMPLE, TEX.—J. T. Gillett, D. S. Galligher and others are asking for a franchise to establish an electric street car line.

SING SING, N. Y.—The subject of extending the Ossining Electric Railway from Sing Sing to Pleasantville has been revived.

BELLOWS FALLS, VT.—The Bellows Falls & Saxtons River Electric Railway will be built early in the Spring. The distance is five miles.

HYATTSVILLE, MD.—The Columbia & Maryland Electric Railway has been granted permission to construct tracks through Hyattsville.

BATH, N. Y.—Highway Commissioner Clarence Hubbard signed the franchise granting the electric railway the right of way through the town of Bath.

BOSTON, MASS.—The West End Street Railway Company is planning the construction of a circuit line through Allston, Brighton, Newton, Watertown and Cambridge this Spring.

MONROEVILLE, O.—W. W. Graham, the promoter of the new electric railway from Sandusky to Bellevue, via Monroeville, has just returned from New York, where he has arranged for the sale of the bonds.

EASTHAMPON, MASS.—The Mt. Tom Electric Railway will be built this year if the permission of the Legislature for the incorporation of the company can be secured. W. S. Loomis is at the head of the movement.

FREELAND, PA.—It is rumored that the Lehigh Traction Company is endeavoring to obtain control of the Jersey Central branch leading from Eckley to Drifton, with the hope of extending the trolley line to Eckley.

McKEESPORT, PA.—The McKeesport Electric Railway Company has secured rights of way to extend its line from McKeesport through Riverton, Denmier and Saltsburg to Port Berry. This route will be occupied this Spring.

CHEBOYGAN, MICH.—Daniel J. Kennedy has secured a railway franchise in Cheboygan, and will transform his horse line into a trolley system as soon as the warm weather sets in. He has one and one half miles of roadway yet to build.

QUINCY, MASS.—The Quincy & Boston Street Railway Company have recently placed an order for about 10 miles of rails. The company intends in the Spring to rebuild the Neponset and Quincy Point routes. A 60-foot rail will be used on the latter route.

MILWAUKEE, WIS.—A New York and Detroit syndicate, at the head of which is J. A. McDonald, of Detroit, has purchased the Milwaukee & Wauwatosa motor line for $500,000, which will be changed to an electric line and extended to Wisconsin lake resorts.

NORTH HEMPSTEAD, L. I., N. Y.—The scheme to build a trolley railway in North Hempstead has been revived. The proposed line is to run from Great Neck Landing to the North Hempstead turnpike and connect with lines to Port Washington and Roslyn.

NEW CANAAN, CONN.—The New Canaan Selectmen have issued an order granting the Norwalk Tramway Company permission to build the road through that town extending it from Norwalk. The road must be completed by Dec. 1, and the company must give a bond of $10,000.

MANKATO, MINN.—The Mankato City Council has accepted a proposition from L. E. Watkins, of Boston, to light the city by electricity, at $56 per arc light, and in connection with this Mr. Watkins agrees to operate within four years an electric street railway five miles in length.

CATLETTSBURG, KY.—The Ashland & Catlettsburg Street Railway Company, whose right of way soon expires through this city, has asked for an extension of 60 days, which the Council will grant at its meeting. The road which has been completed to the northern limits for the past 10 months, will be rapidly extended through the city.

SPRINGFIELD, O.—Mr. Jacob Olinger, of Vienna, is engaged in procuring the right of way for a road to be built along the National Road from this city to the Madison County line. The road is said to be backed by Mayor P. P. Mast, a millionaire manufacturer of this city, and Mr. John Foos, and it is also said that it will be built on to Columbus.

LONG BRANCH, N. J.—The Long Branch, Red Bank & Atlantic Highlands Trolley Company has made application to the Red Bank Commissioners for a franchise to extend its track on Shrewsbury Avenue, as far north as Front Street and down Front to Railroad Avenue to a point close by the south end of the N. J. S. R. R. bridge. Other franchises for Red Bank streets are also asked.

COHOES, N. Y.—An application has been made to Abram Freleigh, Highway Commissioner of the town of Colonie, for permission to construct, maintain and operate a surface railway in the town of Colonie. A hearing will be held at Latham's Corners, March 24. The object of the company is to get into West Troy from Cohoes through the town of Colonie, to connect with the Albany railway.

Trade and Industrial Notes.

THE HESS STORAGE BATTERY COMPANY, of Philadelphia, formerly of 246 Arch Street, has removed to 116 North Third Street.

THE UNIVERSAL FIRE ALARM COMPANY, 925 Chestnut Street, Philadelphia, is being congratulated upon the excellent results obtained from a test of its system at Ardmore, Pa., on Washington's Birthday. The test, which was an official one, was witnessed by several hundred citizens, and in speeches made after the test, by city officials and others, the result of the trial was spoken of in the highest terms.

WM. T. PRINGLE & CO., electrical engineers and machinists, 1028 Filbert Street, Philadelphia, Pa., state that their "Improved Attachment Plug" is increasing in favor each day, as shown by the increasing demand for them. The plugs are used in the new Hotel Walton, Pennsylvania Hospital and the Fidelity Mutual Building, of Philadelphia, as well as other new buildings in that city and New York. They have recently established agencies in San Francisco, Boston and Chicago.

MODERN ARCHITECTURAL DESIGN.—In a handsome pamphlet, entitled "A Few Buildings," the Simplex Electrical Company, of 75 Cornhill, Boston, gives well-executed half-tone engravings of a number of the most important of recent public and office buildings in the United States, the unobtrusive legend "wired with simplex wire," accompanying each engraving. Some of the engravings are unusually well executed, particularly those of the Capitol and Congressional Library at Washington.

THE DAVIS & EGAN MACHINE-TOOL COMPANY, Cincinnati, O., is distributing a handsome chart, containing a large number of illustrations of its standard machine tools. The engravings are well executed, all wood cuts, and the excellent general effect is due as much to this fact as the good taste shown in their arrangement. It is with pleasure that we note a tendency on the part of the more important manufacturing companies to ignore the half-tone, which is entirely unsuitable for technical purposes

SILK WASTE MACHINE WIPERS.—From a note in these columns several weeks ago concerning the silk waste machine wipers made by the American Silk Manufacturing Company, 311 Walnut Street, Philadelphia, the impression might have been derived that the silk waste is used about machinery in the same state as cotton waste. This, of course, is an error, as it is woven in the form of a fabric; of this fact, however, perhaps almost all of our readers were aware through personal knowledge of this widely used convenience.

J. E. RHOADS & SONS, 239 Market Street, Philadelphia, have added to their already full stock of oak-tanned belting still another style of belt. This is a high-grade, medium-weight, short-lap, oil-treated and rivetless belt, which has been put in stock in response to frequent calls for a high-speed belt. The Rhoads firm have recently made tests of their belting in comparison with some other high-grade makes, which showed to their satisfaction that their "Gilt-Edge Short Gap" is the peer of the very best brands, both for tensile strength and minimized stretch.

AUTOMATIC ENGINES.—In the handsomest engine catalogue that has ever come to our desk, the Atlas Engine Works of Indianapolis, Ind., describes and illustrates the various types of self-contained engines of its manufacture, and also the boilers suitable to each type. The catalogue is in execution a fine example of the typographical and engraver's art. All of the numerous illustrations are beautifully engraved wood-cuts, and the engine details thus clearly shown render the pamphlet of educational value to those wishing to keep abreast of the latest practice in steam engine design.

WILFRED H. FLEMING, 393 Pearl Street, New York, has received a flattering letter from Mr. David Howe, electrician of Reed & Barton, the well-known silversmiths of Taunton, Mass., relative to the wear of his dynamo brush. Mr. Howe states that he finds the wear on brushes of three machines in use from one to two years averaged only about one half inch yearly and as the brushes were five and seven inches long when new, new ones will not be needed for some years. With commutators in proper condition, he states, and with brushes correctly adjusted, the wear is hardly noticeable

THE HORN & BRANNEN MANUFACTURING COMPANY, of 427 North Broad Street, Philadelphia, whose building was recently partially destroyed by fire, has let a contract for a new five-story building. That portion of its building which was not destroyed will have another story added to it. The new building will have a frontage of 90 feet on North Broad Street, by 148 feet on Noble Street, and is expected to be completed by July 1. Temporary salesrooms are now occupied at 211 and 213 North Broad Street, and the firm is now in a position to handle business as before, and is thoroughly busy, running full time.

THE NATIONAL UNDERGROUND CABLE COMPANY, Times Building, New York, has just received from the Central Union Telephone Company a very large contract for telephone cable for the City of Toledo, the contract covering also the laying, jointing and connecting of the cables, etc. This is claimed to be the largest single telephone cable order given out in the year 1896, and the National Company is to be congratulated upon the receipt of it. This progressive and enterprising company has booked during the week also several large orders for electric light and street railway cables; and is rapidly making itself felt in the line of telegraph cables for the manufacture of which it has a special department in its factories at Harrison, N. J.

NUERNBERG CARBONS.—In a recent circular, Mr. Hugo Reisinger, 38 Beaver Street, New York, points out the high merits of "Electra" high-grade Nuernberg carbons, of which he is the American agent. The claim is made that this make of carbons will cost less per given hours of burning than any other carbon listed at a lower price, and that they will furnish more light for the same power expended on the lamp, or the same light for less power, and will burn steadier and produce less dust than any other make of carbon, either foreign or domestic. Mr. Reisinger claims that the difference in the efficiency of "Electra" carbons and other foreign lamp carbons is from 10 to 25 per cent. and that the difference between this brand and domestic carbons is from 25 to 30 per cent.

THE AMERICAN ELECTRICAL HEATING COMPANY, of Boston, Mass., has been reorganized and is now in the hands of a syndicate, including Charles E. Morss, William Endicott, Jr, Charles E. Perkins, Charles J. Paine, Oliver Ames, E. S. Converse, C. C. Converse, E. I. Corning, Thomas Nelson, E. N. Fenne, A. R. Whittier, Jackson Curtis, E. D. Barbour, Robert Bradley, Peter Bradley, Robert Treat Paine and others. The new Board of Directors will consist of J. Murray Forbes, president; Charles E. Morss, Jr., Edward C. Perkins, Charles L. Edgar, Charles Francis Adams, second, Evert Morss, Arthur B. Smith, George U. Crocker and Ambrose Eastman, of Boston; S. S. Wheeler and Arthur H. Dodge, of New York; H. B. Scott, of Burlington, Ia. The concerns that have been absorbed by the American Electrical Heating Company are as follows: The Western Electrical Heating Company, St. Paul, Minn.; Central Electric Heating Company, of New York; New England Electric Heating Company, Boston; Burton Electric Company, Richmond, Va.; Carpenter Electric Heating and Manufacturing Company, St. Paul, Minn.; Dewey Electric Heating Company, Syracuse, N. Y., and the Rich Electric Heating Company, Mt. Vernon, N. Y., as well as several others which have not been active in the business for some time, but which owned electrical heating patents. The company has established a laboratory for special work, and several improvements are in hand which have proved to be desirable additions. The manufacturing will be concentrated at Cambridgeport, Mass. The head office is at 611 Sears Building, Boston, with agencies in New York and Chicago. Mr. James I. Ayer, ex-president of the National Electric Light Association, is general manager.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 25, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

555,381. BRUSH FOR DYNAMO-ELECTRIC MACHINES AND MOTORS; F. W. Kreinberg, Elsey, Germany. App. filed Feb. 17, 1894. A brush formed of a bundle of fine wires braided together and saturated with an lubricant, and a casing inclosing the wires and lubricant.

555,470. SECTIONAL CONDUCTOR FOR ELECTRICAL RAILWAYS; W. H. Baker, Providence, R. I. App. filed March 21, 1895. In a sectional electric railway the combination of conductor sections, mechanical means whereby the moving trolley is caused to progressively connect the said sections with a continuous electric conductor or feeder, said means comprising a lever at the initial end of each section arranged to be depressed by said trolley as the latter advances upon the said section and a second lever arranged to be depressed by the first-named lever and constituting an electrode of the conductor section adapted to make contact with an electrode of the continuous conductor, and an electromagnet continuous with the electrode of the continuous conductor and arranged to co-operate with the second named lever as an armature and thereby restrain the electrodes in contact after the trolley has become disengaged from the first-named lever and during its engagement with the conductor section.

UNITED STATES PATENTS ISSUED MARCH 3, 1896.

555,487. CLOSED CONDUIT ELECTRIC RAILWAY; C. Anderson, Leeds, Eng. App. filed March 1, 1894. In an apparatus for operating electric railways from an underground supply cable, the combination with a series of vertically movable contact-pegs adapted to complete the circuit between the car motor and the said electric supply cable and a peg-actuating mechanism arranged in a series of boxes together with said contact pegs, of a mechanical and positive means for elevating a peg in one box by the depression of a peg in the box next behind through suitable connections from box to box.

555,488. CLOSED CONDUIT ELECTRIC RAILWAY; C. Anderson, Leeds, England. App. filed Feb. 13, 1895. In an apparatus for operating electric railways from an underground electric supply cable, the combination of a series of vertically movable contact-pegs adapted to complete the circuit between the car motor and said electric supply cable, a series of vertically movable mechanical pegs, each provided with a stud or cross arm that carries one of the contact pegs, a series of boxes arranged at intervals for containing said pegs, lever mechanism located in each of said boxes, a link having its lower end connected to said lever mechanism, and its upper end connected to the stud or cross arm that connects a mechanical peg and a contact-peg, connections from the lever mechanism in each box to the similar lever mechanisms in adjacent boxes, and a ramp, carried beneath a car, to engage a raised mechanical peg and cause the depression of the pegs in one box to elevate the pegs in the next forward box.

555,491. DISTRICT ALARM SYSTEM; M. E. Barrett, Chicago, Ill. App. filed April 16, 1895. In a district alarm system, the combination with two metallic lines extending throughout the district to be protected, said lines being closed upon themselves to form two round circuits of a battery, and a responsive device in a bridge between said lines at the central station, a pair of contacts provided in each of said lines at the central station, and testing apparatus to be connected to the end of said lines when said contacts are separated to thus include the lines in circuit between the testing set at one end and the battery and responsive device at the other end.

555,503. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; L. T. Gibbs, Milwaukee, Wis. App. filed Jan. 2, 1896. In a controlling mechanism for electric motors, the combination with a lever adapted to gradually cut out of the armature circuit a series of resistances in starting the motor, of an automatic safety switch comprising an arm electrically connected with said lever, and movable independently thereof, an electromagnet having its winding in series with the field, of the motor and its core or pole-piece projecting into the path of said arm, and in electrical connection with the armature circuit, and a spring arranged to pull said arm out of contact with said pole-piece when said magnet is de-energized and the switch lever is in its final position.

555,509. ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed June 21, 1894. The method of operating parallel railways by electricity which consists in supplying to electrically propelled vehicles upon the two railways, currents of opposite polarity from a stationary source of electrical energy, and immediately uniting the said currents after energizing the motors on said cars in a common circuit in electrical connection with the earth, whereby said currents do not traverse the earth parallel to the tracks for any material distance, and automatically supplying an increased current from a conductor of either track to the conductor of opposite polarity of the other track when a car is upon said track and not upon the other track.

555,511. METHOD OF CONVERTING POTENTIAL ENERGY OF CARBON INTO ELECTRICAL ENERGY; W. W. Jacques, Newton, Mass. App. filed June 5, 1895. The method of converting the potential energy of carbon or carbonaceous materials into electrical energy, which consists in chemically combining oxygen with said carbon or carbonaceous materials through an intervening electrode.

555,544. DYNAMO-ELECTRIC MACHINE AND ELECTRIC MOTOR; G. A. Welles, Jr., New York, N. Y. App. filed April 12, 1895. In a dynamo or motor a multipolar electromagnet provided with alternating pole-pieces U-shaped in form, to thereby embrace inside and outside an armature constructed to register therewith, in combination with a supporting spider for the commutator brushes secured to the outer ends of the U-shaped pole-pieces of similar sign.

555,546. ELECTROMAGNET FOR SEPARATING METALS; H. H. Whitacre and A. C. Wolfe, Wellsville, O. App. filed March 1, 1895. In a hand manipulated magnetic separator the combination of a series of magnets radially disposed about and parallel with a central axis, core extensions of said magnets coincident with the central axis of the separator, radially disposed, intermediate pieces connecting said core extensions, and said series of magnets, a coil surrounding the core extensions and abutting against the radial intermediate pieces, a hermetic jacket enclosing the coil, a handle secured to the core extensions and projecting axially beyond the coil and the magnets.

555,571. TROLLEY POLE AND CONNECTION; C. H. Finson, Pittsfield, Me. App. filed July 20, 1895. In a trolley pole and connections therewith for electric cars the combination of the following elements, viz., a tubular trolley pole swinging vertically from a standard, a stationary ratchet secured to said standard, a pawl pivotally hung from the trolley pole so as to be normally in engagement with the ratchet, a trolley truck pivoted to the pole near its upper ends, an arm or lever pivotally secured to the pole near its upper end held normally forward or downward by a spring, and adapted to be pressed upward or outward by the said truck when the trolley is forced down by its contact with the upper side of the wire, and a cord or wire extending from said swinging arm or lever down through the trolley pole to said pawl whereby the pawl is held out of engagement with the ratchet when the trolley is in contact with the under side of the wire, and is allowed to engage said ratchet when the trolley slips off the wire.

555,585. SAFETY APPLIANCE FOR ELECTRIC BRAKES; W. B. Potter, Schenectady, N. Y. App. filed April 22, 1895. A safety appliance for an electric brake comprising a breaking switch, a circuit including brake-magnets, and a source of E. M. F., a solenoid having its core attached to and controlling the breaking-switch, and means for actuating the solenoid by excess of current in the circuit.

555,589. ELECTRIC METER; G. A. J. Telge, Oldenburg, Germany. App. filed Feb. 21, 1895. An electricity-meter comprising a pair of normally synchronous indicators, and a device under control of the current to be measured having oppositely working regulating connections with the indicating mechanisms for adjusting them simultaneously in opposite directions, and thus differentiating their readings proportionately to the controlling current.

555,590. MONOCYCLIC GENERATOR; E. Thomson, Swampscott, Mass. App. filed March 29, 1895. In a monocyclic generator, a main armature generating single-phase alternating current, an auxiliary armature comprising a winding upon a separate core from the main armature but mechanically connected with the main armature, and generating an E. M. F. of displaced phase, and a connection between the teaser-armature and the main armature.

555,601. ELECTRICAL RAILWAY SIGNAL; W. Fiedler, Charlottenburg, Germany. App. filed Aug. 25, 1894. The combination of a semaphore-arm, a rod, a rotary disc, an eccentrically placed pin in said disc, in connection with said rod, an electric motor, a wheel train adapted to be revolved by said motor and to communicate the rotary motion thereof to the disc, a ratchet wheel and pawl interposed in said wheel train for permitting further rotary movement of said disc on arrest of said motor, an arm and a pin adapted to move with said wheel-train, a three-armed lever adapted to co-operate with said arm and pin, a circuit controlling the motor, an operating key at the place of control, and a contact under control of said three-armed lever, a branch circuit, an electromagnet in said branch circuit, an armature thereto and a hook adapted to be operated by said armature to arrest the three-armed lever.

555,621. ELECTRIC ARC LAMP; R. Schefbauer, Hoboken, N. J. App. filed Aug. 8, 1895. The combination with carbon holders, and racks that are moved by the same, of a cross shaft and pinions acted upon by the racks, a ratchet wheel upon the cross-shaft, a loose fly-wheel, a pawl engaging the ratchet-wheel, a magnet in the main circuit through the lamp, a lever acted upon by the same, and a clamp to engage the fly-wheel and draw the arc.

555,626. FAC-SIMILE TELEGRAPHY; A. W. Storm, Ramsey, N. J. App. filed Sept. 11, 1895. A message-sheet of suitable fabric having a design partly of non-conducting and partly of conducting substance thereon, in combination with a telegraphic transmitter having a circuit-closer with adjacent contact points, and means for moving said contact points across the message sheet and electrical connections to such points, adapted to close a circuit through said points and through the conducting substance of the design.

555,628. ARMATURE FOR DYNAMOS AND MOTORS; G. A. Welles, Jr., New York, N. Y. App. filed April 12, 1895. A ring armature for a dynamo or motor built up in segmental sections and provided with coils so placed thereon that spaces are left on the outer periphery thereof, in combination with a circular retaining ring secured at one side of said armature, and provided with fingers arranged to enter said spaces, whereby the segmental sections are held and secured together.

555,634. TROLLEY PROTECTOR FOR FIREMEN; J. P. Barrett, Chicago, Ill. App. filed Dec. 13, 1895. In a trolley protector for firemen the combination with a support adapted between the trolley-conductor and the track, of a contact device provided at the upper end of the protector for engaging the trolley conductor, and a shoe or shoes electrically connected with said contact device carried at the lower end of the support and adapted to engage one or both of the rails.

555,645. TELEPHONE CALL REGISTER; H. Hempel, Berlin, Germany. App. filed April 9, 1895. A conversation indicator for telephones characterized by a bolt, the pointed head of which in its highest position engages with a star wheel, secured on the ringing crank-axle and the pin, on the bolt of which is so connected with counting mechanism that either the upward or downward movement of the bolt effects a unit movement of the counting mechanism in such a way as to indicate the number of connections made for the purpose of conversation, while a pin likewise fastened onto the bolt is so connected with a lever arm and pin, that, on pressing down the bolt, the pin rests upon the second lever arm and on the upward

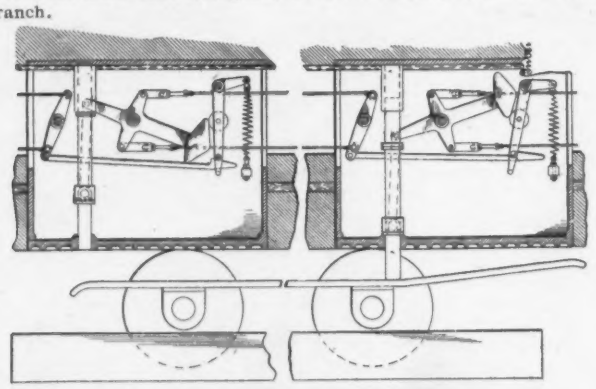
movement of this lever arm induced by the hanging of the receiver, the other lever arm and with it the bolt, is pressed up, and by this means the further turning of the crank is prevented.

555,674. TROLLEY HEAD; W. H. Carr, Bath, Me. App. filed Oct. 15, 1895. The combination of a rod having a threaded end, a head having a socket to receive said end, a flat flexible plate secured to said head and having one of the securing-bolts engaging the threads in the end of the rod, the trolley carried pivoted on said head, ball bearings between the head and the carrier, the trolley mounted in the carrier, the ball bearings for said trolley, and the spring having one end connected rigidly to the front of the head and the other end loosely engaging the front of the trolley-carrier.

555,702. ELECTRICAL MEASURING INSTRUMENT; A. H. Hoyt, Penacook, N. H. App. filed June 10, 1895. In an electrical measuring instrument, the combination with the stationary member, of a movable member, a spring arm forming the sole support and guide for said movable member, a pointer connected with said movable member and adapted to travel over a graduated scale.

555,706. ELECTRIC ARC LAMP; E. Lavens, New York, N. Y. App. filed May 23, 1895. In an arc lamp, the combination of a movable carbon-support, a shaft carrying a wheel or drum from which the carbon-support is suspended, a clutch wheel mounted on said shaft, a gravitally acting armature which normally overcomes the weight of the carbon-support having the same axis of rotation as said shaft, but independent thereof, and a breaking device carried by, and moving with the armature, which normally acts upon said clutch wheel to prevent the downward movement of the carbon-support, but which permits free upward movement of said support, and a magnet for moving said armature and break device.

555,707. SIGNALING CIRCUIT; J. J. O'Connell, Chicago, Ill. App. filed Dec. 23, 1895. In an electric circuit the combination of a high resistance signaling instrument connected therewith; a signal current generator, a key or circuit changer controlling the said generator and adapted to connect it with the said circuit; an automatic locking device for the said key adapted to hold the same in operative position, means for strengthening the said signaling current after the signal has been received, consisting of a normally open branch circuit of relatively low resistance associated in parallel with the said signaling instrument, and a switch for closing the same to reduce the circuit resistance; and a releasing electromagnet associated with the said key, and adapted to unlock the same, the said magnet being irresponsive to the normal signaling current, but responsive to the same when strengthened by the closure of the low resistance branch.



No. 555,488.—Closed Conduit Electric Railway.

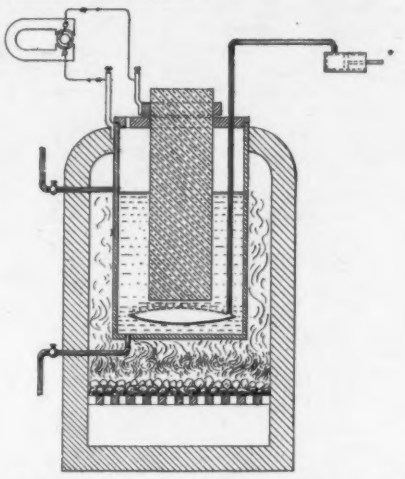
555,725. PARTY TELEPHONE LINE APPARATUS; A. S. Hibbard, Chicago, Ill. App. filed Sept. 16, 1895. In a party telephone line the combination with two metallic limbs extending from the central station through four sub-stations, of a telephone set at each of said sub-stations connected in a normally open bridge extending between the two metallic limbs, whereby the telephone set at any one of the sub-stations may be individually connected between the metallic limbs, a call device at each of said sub-stations, two of said call devices being oppositely polarized and connected between one of said metallic limbs and ground, the remaining two call devices being oppositely polarized and connected between the other metallic limb and ground, two generators at the central station, one having the positive pole grounded, and the other having the negative pole grounded, two keys connected with one of said generators, one key constructed to connect the generator in circuit with one of the metallic limbs, and the other to connect the generator in circuit with the other metallic limb, and two keys connected with a second generator, one constructed to connect the generator with one of the metallic limbs, while the other key is constructed to connect the generator with the other metallic limb.

555,783. ELECTRIC PROPULSION SYSTEM FOR CARS; G. H Melotte, Marsh, Pa. App. filed Aug. 15, 1895. A trolley wire so strung as to cross the path of the trolley at definite intervals in alternate directions, and a trolley of such a length as to always be in contact with one or more of such crossings.

555,792. METHOD OF AND APPARATUS FOR MAGNETIC SEPARATION; J. P. Wetherill, South Bethlehem, Pa. App. filed Feb. 10, 1896. The method of magnetically separating substances of relatively low magnetic susceptibility from a mixture containing them, which consists in establishing a magnetic circuit, concentrating said magnetic circuit across a working area and developing therefrom intense M. M. Fs. sufficient to inductively magnetize such particles of very low magnetic susceptibility, subjecting the mixture to the action of said intense M. M. Fs., and thereby attracting and withdrawing from the mixture the particles to be removed, and progressively removing the withdrawn particles from the field of action of said intense M. M. Fs.

555,793. SEPARATION OF FRANKLINITE ORE AND METALLURGY THEREOF; J. P. Wetherill, South Bethlehem, Pa. App. filed Feb. 10, 1896. The improvement in separating franklinite ore, which consists in comminuting the ore, inductively magnetizing the mineral franklinite in its natural state therein by subjecting it to the action of a highly condensed magnetic field and withdrawing said mineral franklinite by magnetic attraction.

555,794. MAGNETIC SEPARATOR; J. P. Wetherill, South Bethlehem, Pa. App. filed Feb. 10, 1896. In a magnetic separator, an electromagnet having a pole-piece tapered toward its free end, said free end being of less sectional area than the magnet cores, so as to highly condense the lines of magnetic force, an ore-conveyer below, and in close proximity to said tapering end, and conveying the ore through a portion of the highly-concentrated field, the tapering end of the pole-pieces being arranged transversely to the direction of travel of the conveyor, and a second conveyor for withdrawing the attracted particles.



No. 555,511.—Method of Converting Energy of Carbons.

555,800. ELECTRIC RAILWAY SYSTEM; A. J. Beitzel, Boiling Springs, Pa. App. filed April 15, 1895. In an electric system a series of switches electrically connected, contact points extending from the plate of the switch to the surface of the roadbed, a contact lever connected with a transversely-extending rod with its ends alternately protruded into the grooves of the rails on opposite sides of the track, and means at the front and the rear of the car for operating the rods.

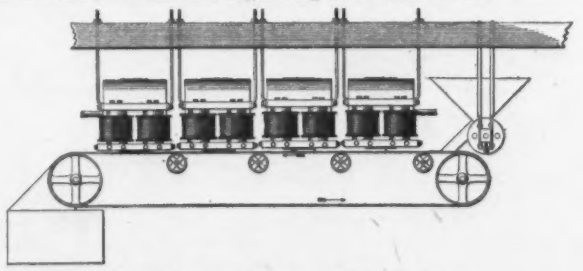
555,841. ELECTRIC ARC LAMP; T. E. Adams, Cleveland, O. App. filed June 6, 1895. In an electric arc lamp the combination with the carbon rod, and a clutch having jaws disposed at diametrically-opposite sides of said carbon-rod, of graphite facings on said jaws, said graphite facings being thus adapted to receive the carbon-rod between them and engage the same at diametrically opposite points.

555,846. BOND OR CONNECTOR FOR ELECTRIC RAILWAYS OR OTHER ELECTRIC CONDUCTORS; A. Bournonville and J. J. Zimmele, Philadelphia, Pa. App. filed Sept. 20, 1895. A bond or connector for an electric conductor forming a bar having a body half-round or segmental in cross-section, and an end reversed on itself, forming a divided head which is adapted to be spread apart.

555,850. CORE AND COIL FOR DYNAMO-ELECTRIC MACHINES; A. L. Cushman, Concord, N. H. App. filed Aug. 29, 1894. In dynamo-electric machines, an inductive core provided with grooves or recesses of equal width from top to bottom, coils or windings composed of insulated wire all equal length, and suitable end caps for inclosing the coils or windings, each having an internally-projecting flange or ring adapted to support said coils.

555,851. ARMATURE FOR INDUCTION MOTORS; A. L. Cushman, Concord, N. H. App. filed Aug. 13, 1894. In an armature for induction motors a laminated core, and separate and distinct windings consisting of a multiple closed circuit coils and short circuit coils closed in series, all arranged in such relation one to the other as to produce unsymmetrical polarities upon said armature.

555,862. ELECTRIC RAILWAY BRAKE; J. C. Henry, Westfield, N. J. App. filed July 3, 1895. In a momentum brake the combination with a car, of a magnetic clutch, a dynamo-electric generator on the car, and in power connection with one of the car-axles, and in electrical connection with said clutch; a circuit closer on the car controlling the circuit of the said dynamo electric machine; an electric actuating device for said circuit closer, and means on the locomotive for regulating said electric device.



No. 555,794.—Magnetic Separator.

555,891. ELECTRIC ARC LAMP; T. E. Adams, Cleveland, O. App. filed Oct. 10, 1895. In an arc lamp, the combination with a separating magnet and the carbons, of a pivoted lever connected with the armature of the magnet and with the carbons, and a dash-pot having its piston connected with the lever, the bore of said dash-pot being larger at one end than the other;